SUBSCRIPTION RATES:

The Annual Subscription, post free, to any part of the world is 21/- (English) or its equivalent in other currency. The price of single copies is 1/6, or 1/9 if sent by post. Back numbers (when available) are charged double if over six months old.

CONTRIBUTIONS:

All Letters and Contributions intended for Publication should be addressed to:—
K. R. DOGGETT, Assoc.I.C.E., Editor,
"The Dock and Harbour Authority,"
19, Harcourt Street, London, W.1.
Telephone: PADdington 0077/8.

The Dock & Harbour Authority

No. 348. Vol. XXX OCTOBER, 1949

CONTENTS

Editorial Comments

Reconstruction of two Thames Graving Docks.

The East India and West India Graving Docks—owned by the London Graving Dock Co., have had long and interesting histories. The former, entered from the River Thames, was built on the site of an old shipbuilding yard which was well established when ships were being built for use against the French in the Napoleonic Wars. Originally a fitting out tidal basin or slipway, it was converted into a dry dock in 1859. On the other hand, the West India Graving Dock was built in 1879 as a dry dock, entered from the Blackwall Basin of the West India Docks.

Both docks are situated in the district of Poplar, known as Blackwall, between the South West India Docks and the East India Docks of the Port of London Authority, which a century or so ago, was the home of the East and West Indiamen and later of the tea and wool clippers.

Like very many other structures in London, these docks might have lasted for many more years without major structural repair, had it not been for the effects of the bombing of the last War. Unfortunately however, concussion from the many high explosive bombs which fell nearby, cracked the walls and floor of the East India Graving Dock, and a direct hit resulted in severe damage being sustained by the other dock.

The repairs and reconstruction subsequently put in hand were under the direction of Mr. F. W. Davis, late Chief Assistant Engineer of the Port of London Authority, to whom we are indebted for the article which is to be found on the following page.

It will be seen that the conditions entailed by the owners desire to improve the usefulness of the dry docks imposed some difficult problems for solution, especially as the East India dock was of very composite construction, largely unknown, and no drawings of any sort existed in the case of the other Dock. The methods which were finally adopted will be found both interesting and instructive.

In particular, attention should be drawn to the circumstances that the floor of the East India dock was badly damaged and was also to be lowered eighteen inches, so that reconstruction with a completely new reinforced concrete invert was necessary. The damaged walls were supported by reinforced concrete buttresses at fifteen feet centres cast monolithically with a reinforced concrete invert strip 6-ft. 6-in. in width, while intermediate invert strips 8-ft. 6-in. wide gave additional support to the walls throughout the depth of the haunching.

This type of rib-like repair, resembling a ship's frame, is probably unique; by constructing the floor in strips, both the risk of collapse of the walls and the necessity for more extensive temporary strutting were avoided.

Other constructional problems of major importance which occurred in both docks were those of dealing with water, which owing to the nature of the soil, principally ballast above the clay, and the proximity of the River Thames, enabled water in great quantity at high tide to boil up under considerable pressure through the cracks in the floors and walls.

The measures adopted to counteract this and other site difficulties, are ably dealt with in the article and shewn on the drawings and photographs which accompany it.

The International Navigation Congress.

The XVIIth International Navigation Congress held this year in Lisbon was originally planned to take place in June 1940 in Berlin, but owing to the War was of course postponed.

In this issue will be found the abridged General Reports upon certain papers submitted to the Congress and it will be observed that the ground covered is very wide in scope. It is our intention to publish the other reports—on Communications 1, 2 and 3 of Inland Navigation in our November issue, while in respect to Ocean Navigation—Questions 1 and 2 will appear in December and Communications 1—4 in the issue of January 1950.

A study of the papers themselves reveals a range of subjects so extensive, that it becomes obvious at once that it was impossible for the Reports to form anything more than the barest general reviews. As many of the subjects are of importance and general interest to readers of this journal, we are hoping to be in a position, as opportunity arises, to refer to them again in greater detail in future issues.

For example, among the fifteen papers upon New Development in Design and Construction of Locks, segmental lock gates on the Continental canals are dealt with—a type used, not only to close a lock, but also to effect its filling and emptying without the use of any other mechanism or culverts—a system quite effective for dealing with heads of water up to five metres.

Many other types of lock gates are the subject of communications —tilting, lifting and sliding, together with emptying and filling devices. Tainter valve sluices and other sluice types, with and without culverts and all merit some attention, not only in respect

Editorial Comments—continued

to canal locks, but also as to their application to dock entrance locks of far greater dimensions.

In this connection the papers submitted upon the "Means for dealing with large differences of head" may be regarded as complementary to "Design and Construction of Locks" and some interesting information from many sources is to be found here. Protection of the banks and beds of waterways forms another interesting group of papers worthy of study.

Under Ocean Navigation it is probable that the papers of the greatest value and interest to Dock and Harbour Engineers will be found among those dealing with the "Improvement of Estuaries," "Coast Erosion" and "Waves in Harbours."

While the Continent of Europe and the United States of America appear to have been well represented at the Conferenc, it is noticeable that neither Soviet Russia, nor South America, with the exception of Chile, nor any country of the British Commonwealth excepting the United Kingdom, submitted any communication. We feel that British engineering should be more in the forefront, for the engineers and scientists of the Commonwealth have a contribution to make which should be of extreme value in many respects.

The Navigation Congress forms an excellent international medium for the exchange and pooling of knowledge and experience, and we hope to see its scope and usefulness greatly extended in the future.

Pallet Standardisation.

In our last issue, we commented upon Pallet Standardisation and Packaging methods, and also published an abridged report of the research carried out by the Swedish Railways. Our observations have aroused considerable interest, and we have since been informed that a special Committee of the British Railway Executive is now studying the whole field of Palletisation, Fork Lift Trucks and Standardisation of Pallet sizes; similar studies are also being undertaken by the Inter-Services Standardisation Committee and the stores division of the Admiralty.

We have now received from the British Standards Institution an account of work recently carried out by them on the related problem of packaging practice, and further details will be found on page 181.

It appears therefore that, as we have already suggested, the present time is opportune for further research collaboration, both national and international, and it may be that the British Standards Institution in view of their work respecting packaging standards, could play a prominent part in the proceedings regarding Standard Pallets.

Standard of Packaging.

In connection with the foregoing, so much of the success of this country's export drive depends upon efficient packaging that the Packaging Standards Committee (and its Technical Committees) which have been engaged in revising the British Standard Packaging Code, have drawn particular attention to the issue of the second edition (B.S. 1133) on the 1st September last, in the hopes that it will be given the greatest possible publicity and secure widespread recognition and adoption throughout industry.

In outlining a set of recommendations for the immeasurables of packaging practice, as well as applying standards of performance and test for the materials used, the Institution has produced a thoroughly practical reference document.

It now remains for British industry to emphasise the high quality of British goods in foreign markets by adopting the principles of the Packaging Code, as there is no question that adequate standards of packaging are essential if this country is to gain the urgently needed business and goodwill in the difficult sellers' market which is already becoming apparent in various parts of the world.

We risk losing markets because of poor packaging, and evidence is available on all sides that there is still too much tolerance of carelessness in packing. It should therefore be borne in mind that the standard of our packaging now will count for or against us when overseas customers once more are able to choose their own sources of supply.

Cine-photography under the Sea.

The Department of Naval Information of the Admiralty announce that methods have been recently developed at the Admiralty Research Laboratory for taking cine films under the sea in normal daylight illumination and by artificial light at night. A frogman diver wearing a self-contained air-breathing apparatus swims in perfect freedom with the camera at depths down to 100 feet.

The cameras used are electrically-driven and powered by portable batteries in watertight cases. Aperture and focussing controls can be adjusted whilst actually swimming towards the subject being filmed.

Experimental work in the Mediterranean last year determined the distance at which photography was possible for different conditions of water clarity, object tone, sunlight angle, working depth and exposure. In the clearest natural conditions of all, objects up to 30 feet away were sharply recorded, but artificial light projectors have been specially designed for use when adverse conditions of natural light and water clarity might render their use necessary.

The methods have been applied to wreck survey in damage and salvage investigations, marine life studies, sea bed topography, and propeller performance; slow motion films have also been made of the discharge of torpedoes from a submarine whilst in action. Work is continuing in the Royal Naval Scientific Service on behalf of the Director of Boom Defence and other Admiralty Departments.

The application of this photographic technique to the survey of under-water damage to marine structures, and to normal salvage work and certain types of construction of Ports and Docks, would appear to be possible, and seems to merit some enquiry and study by those interested in such branches of work.

A research film has been made summarising the results so far obtained by the Admiralty, and a version of it, edited by the Crown Film Unit, was issued last month by the Central Office of information under the title "Wonders of the Deep."

The Thames River Police.

During last month the 150th Anniversary of the formation of the Thames Police was celebrated, by a River Pageant.

In the eighteenth century there were few enclosed docks of any sort in the River Thames, and vessels lying at anchor in the stream were unloaded into lighters which ferried their cargoes to the wharves on the river banks, where the goods were warehoused for distribution. As many as a thousand or more vessels of 1,200 tons or so, might be in the river at a time, and due to the method of unloading, each would take several weeks to clear. Under these circumstances, the opportunity for theft was considerable, and robbery grew to enormous proportions, carried out on an organised basis by groups of thieves and receivers. The annual losses to merchants and the public revenue were estimated at anywhere between £250,000 and £800,000.

The greatest sufferers appear to have been the East and West India merchant companies, and the evil remained unchecked until about the middle of the century, when these companies petitioned Parliament, and as a result, brought about the formation of the first Marine Police force under Captain John Harriott, with its Headquarters at Wapping. Although he had but few men under his command, this able man, equipped with a sailing cutter and a few rowing boats, within two years successfully and completely broke up the whole robbery organisation and the days of wholesale river piracy were thenceforth over.

The present Thames Police are now organised on a basis similar to other Divisions of the Metropolitan Police of London, although they are numerically the smallest. Their duties are the same—prevention of crime of whatever kind upon the River Thames. They also co-operate with the Harbour Service Officers of the Port of London Authority in securing observance of many of the River Bye-Laws, but have no jurisdiction within the Docks, which are policed by the Authority's own efficient force.

The Thames River Police Division has a fine record, and can claim with pride that it has one of the lowest crime rates in the country.

The East and West India Graving Docks

An Account of their Post-War Reconstruction

By F. W. DAVIS, M.Sc., M.I.C.E.

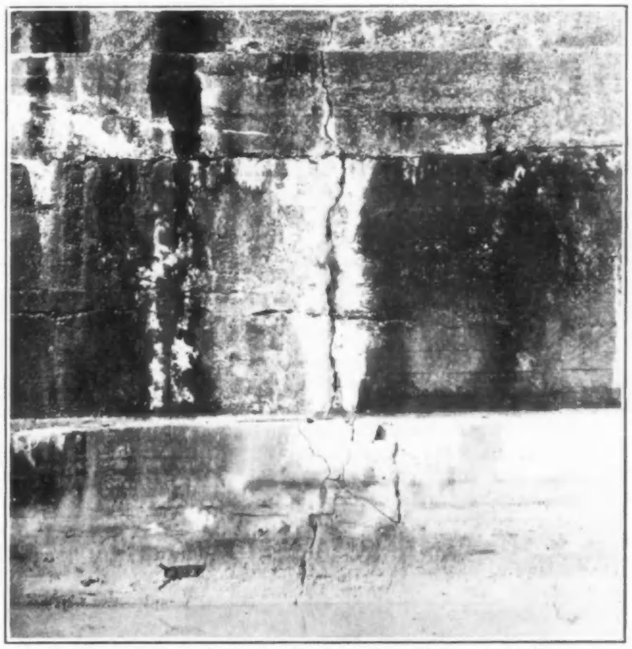
IN the course of many air-raids on London during the recent war, two graving docks on the Thames belonging to the London Graving Dock Co., situated in Poplar, were both hit by high explosive bombs and also suffered other damages from the effects of numerous " near misses." Workshops and buildings were destroyed or extensively damaged from time to time, nevertheless the Docks were kept in operation for ship repairs throughout the hostilities.

The East India Graving Dock

By the end of 1945, the East India Graving Dock (Orchard Place) showed very conclusive signs of distress to which no doubt unavoidable overloading had contributed. The Dock Co. decided to proceed with immediate repairs practically amounting to re-construction and closed the dock for nine months; however by the employment of a system of reinforced concrete, the complete demolition and re-making of the side walls of the dock was avoided.

This dock has a long history, once it was known as the Gladstone Dock and when in the hand of Ditchburn & Mare, some of the earliest iron ships were built there and an interesting brochure by J. Crighton, Junr., gives an account of its ship-building and repairing activities.

Originally on open slipway it was converted into a graving dock with timber side walls and flooring between brickwork knuckles and caisson stop at the entrance and a circular brickwork head. About 1892 the timber flooring was replaced by a vented concrete slab resting on the timber piles which supported and anchored down the original timber grillage. After its conversion into a dry dock, land adjoining on the upstream side was sold to the Union Lighterage Co., who discovered that tie rods and anchor piles holding the side of the dock against earth and hydrostatic thrust, encroached on the land they had acquired. This led to litigation and resulted in an important decision being given in the Court of Appeal ordering the tie rods to be cut. To meet this contingency, the timber side walls were both replaced by mass concrete gravity walls without the assistance of tie rods and were completed in 1903. Projecting bilge altars were subsequently re-made to a modified profile and the cross-section of the dock thus evolved is shown by dotted lines in Fig. 3.



Typical crack in existing wall of dock, which eventually gave indication of serious movement.

The remedial works to put the dock into a safe condition had to satisfy the following requirements:—

1. No diminution of the internal width of the dock.
2. The floor surface to be lowered by 18-in.
3. Removal of the projecting bilge altars both sides.
4. Withstand a surcharge of 1 ton per sq. ft. on ground at back of wall to within 14-ft. of the cope edge.
5. Withstand the hydrostatic uplift without venting the floor.
6. To take a load of 15 tons per 1-ft. on the keel blocks.

The dock has an overall length of 290-ft. inside the caisson, a width of 52-ft. at keel block level, and a depth of 25-ft. below coping at flood prevention level of 18.25-ft. O.D.

The drift gravel in the foundation, extending to a height of 2-ft. above the new floor, is freely water bearing under tidal influence. The gravel was overlaid with Thames mud and made ground.

View of East India Dock before repair.

East and West India Graving Docks—continued

It will be noted from the slenderness of the side walls that stability depended upon tension and high compressive stresses in the concrete. In this condition the dock walls were very susceptible to damage from the shock of high explosive bombs and this was evident by the spalling and cracking, in the bilge altars and extending across the floor which, were not previously noticeable.

The method adopted for stabilising the walls is shown in Figs. 2 and 3. The reinforced concrete for the new floor and sill was generally 3-ft. thick integral with a continuous inset haunching carried up 7-ft. above the floor level. The haunching was extended by inset buttresses at 15-ft. centres to a height of 18-ft. above floor and there connected to new anchor tie rods. The old walls were cut away for the inset haunching and buttresses to avoid any projection into the dock and to enable the width at keel block level to be increased from 47-ft. to 52-ft.

The reinforced concrete was designed to meet the varying conditions from the re-active or hydrostatic uplift and the keel block load on the floor combined with the bending stresses and axial thrust from the side walls. The bending stresses in the haunching being partly relieved by the inset buttresses and anchor tie rods, and to a lesser extent by the value of a gravity wall.

A typical arrangement of the reinforcement is shown in Fig. 4, at the circular head the main reinforcing bars in the floor were similar but placed radially.

The new floor and its haunching was carried out in alternate transverse strips 8-ft. 6-in. and 6-ft. 6-in. wide, the latter being coincident with an inset buttress. The old floor and haunching was split out in corresponding strips to provide a continuous sequence of operations, viz., demolition and excavation, steel fixing, concreting and maturing. Two settings of struts across the dock shored the side walls in the vicinity of the demolitions.

Concrete in the proportions of 1 : 2½ : 3½ was used for the floor and buttresses and in the proportions of 1 : 1½ : 3 for the sill and piles. The steel averages 8.1 lbs. per cub. ft. of concrete throughout, the cover being not less than 3-in. Corrugated copper strips were embedded in the transverse joints of the floor, but were not entirely successful in preventing seepage at the shrinkage

Caisson dry-docked for repairs.

General view of East India Dock showing temporary strutting and repair work in progress.

EAST INDIA GRAVING DOCK—REPAIRS

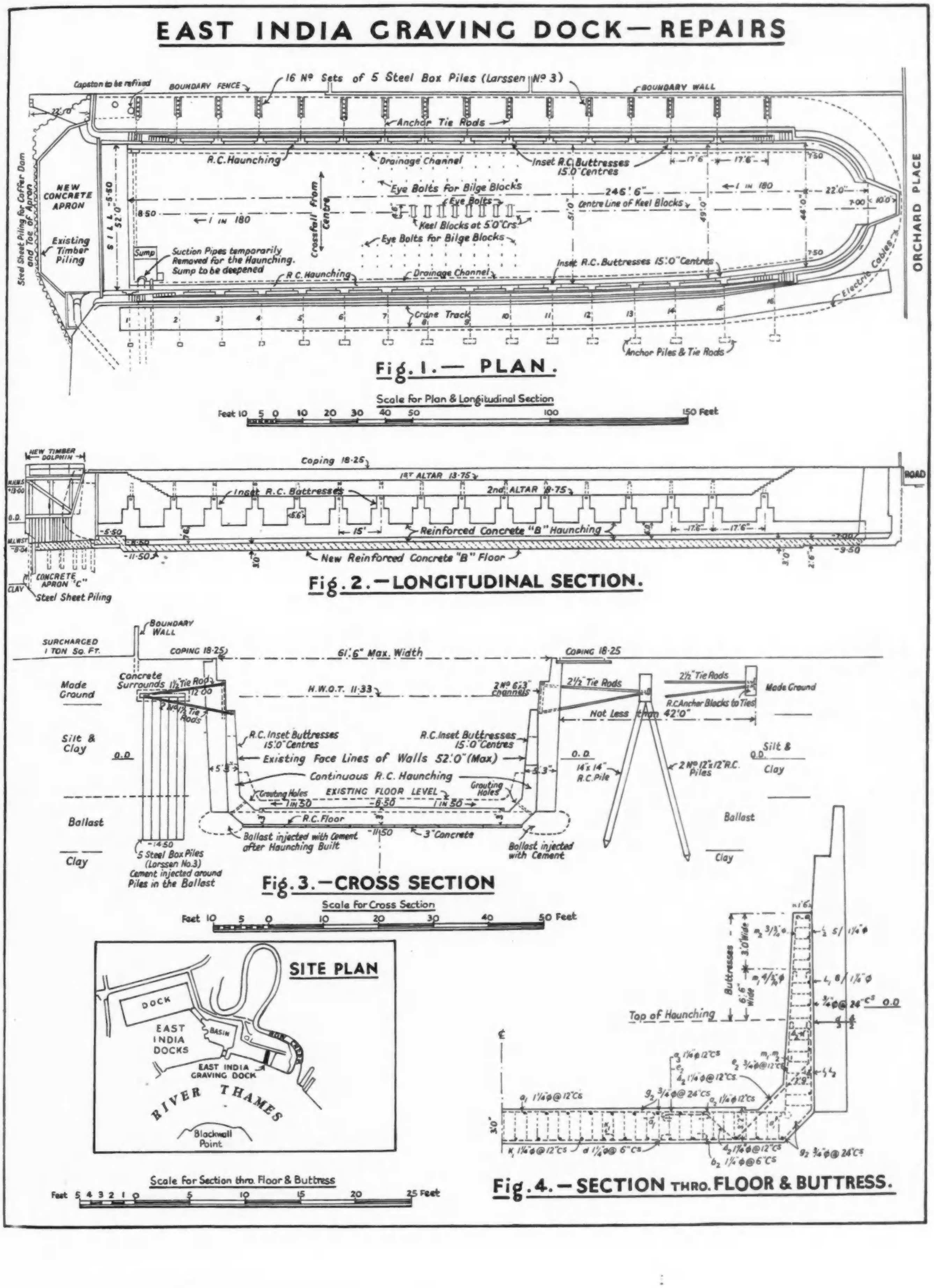


Fig. 1.— PLAN.

Fig. 2.—LONGITUDINAL SECTION.

Fig. 3.—CROSS SECTION

Fig. 4.—SECTION THRO. FLOOR & BUTTRESS.

East and West India Graving Docks—continued

cracks in the floor, the copper strips were unavoidably damaged when splitting out the adjacent section of the old floor concrete.

Depositing concrete in each transverse strip was completed in one operation for the full width of floor.

The gravel foundation was dewatered by two transverse rows of well points at approximately 40-ft. and 100-ft. inside the caisson face, the screened well points were put down to 6-ft. below the underside of the new invert. This was sufficient to control the water plane in the gravel for the whole length of the dock and a dry surface was always obtained on which to deposit the reinforced concrete. The well points were inserted in drilled holes through the floor and then water jetted down to the required level, sleeves were provided in the new concrete for their withdrawal.

The old pile stumps which supported the original grillage, spaced 4½-ft. in each direction were drawn, in fact many fell out when the excavation reached the bottom, a few had to be cut away. The work was carried out by a derrick crane mounted on bogies running on the dock floor and for the greater part of the time, whilst the caisson was in its stops. On completion of a steel sheet cofferdam in the river outside the entrance, the dry dock was temporarily flooded and the caisson floated on to a completed section and there overhauled. The caisson, 86 years of age, built of wrought iron was in a remarkable state of preservation. The wrought iron is reputed to have been rolled by the Thames Iron Works at Bow Creek, but it is uncertain whether the iron was puddled there. During the overhaul none of the original metal required renewal except plates damaged by collision.

The sill and apron and suction pump were then remade, the former in reinforced concrete similar to the floor and the greenheart facings renewed at the same time. The sill was finally grouted through pipes built in to consolidate and seal the ground around existing timber sheet piling beneath the sill.

On the east side of the dock, the inset buttresses were connected to groups of three reinforced concrete raking piles by a pair of 2½-in. diameter steel tie rods with screwed couplings. These pile groups were also utilised for carrying a concrete beam to take the back rail for a future heavy lift travelling crane.

The land available on the opposite side of the dock, not more than 12-ft. wide, did not admit of raking piles and instead, Larsen No. 3 steel box piles were driven vertically tandem fashion in groups of five piles, penetrating well into the gravel bed, to which the two tie rods from each buttress were attached by a steelwork bridle.

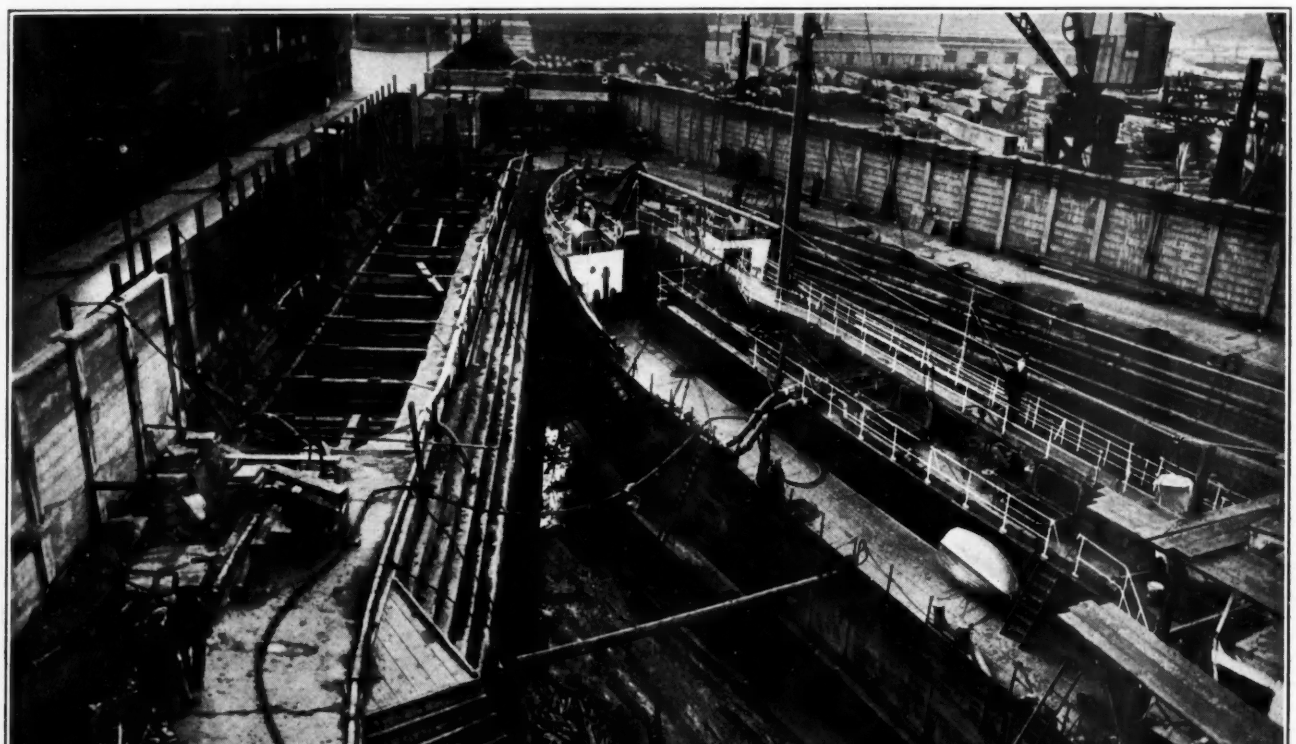
The bases of the walls as well as the steel box piles were finally injected with neat cement grout under pressure through cored and drilled holes, this consolidated the gravel beneath the remaining portion of the old wall that might have been loosened during the excavations.

These works were carried on by day and night from start to finish.

The West India Dock

The second graving dock repaired is entered from the Blackwall Basin of the West India Dock System, which is impounded to M.H.W.S.T. This graving dock has an overall length inside the caisson of 447-ft., a width of 80-ft. at floor level, which varies from 25-ft. to 28-ft. below the coping and gives a depth of 23-ft. on the sill. Its proximity to Prestons Road, the main thoroughfare to the Isle of Dogs, reduced the width of the dock towards the head and considerably reduces the effective length.

The dock was built in 1879, the walls have a brickwork facing backed by lime concrete. No constructional drawings were available, having been destroyed with the buildings. The dock received a direct hit from high explosive bomb and Prestons Road was shaken by " near misses." Whilst carrying out repairs, the



View of West India Dock under repair.

WEST INDIA GRAVING DOCK—ALTERATION TO SPLAY END WALL

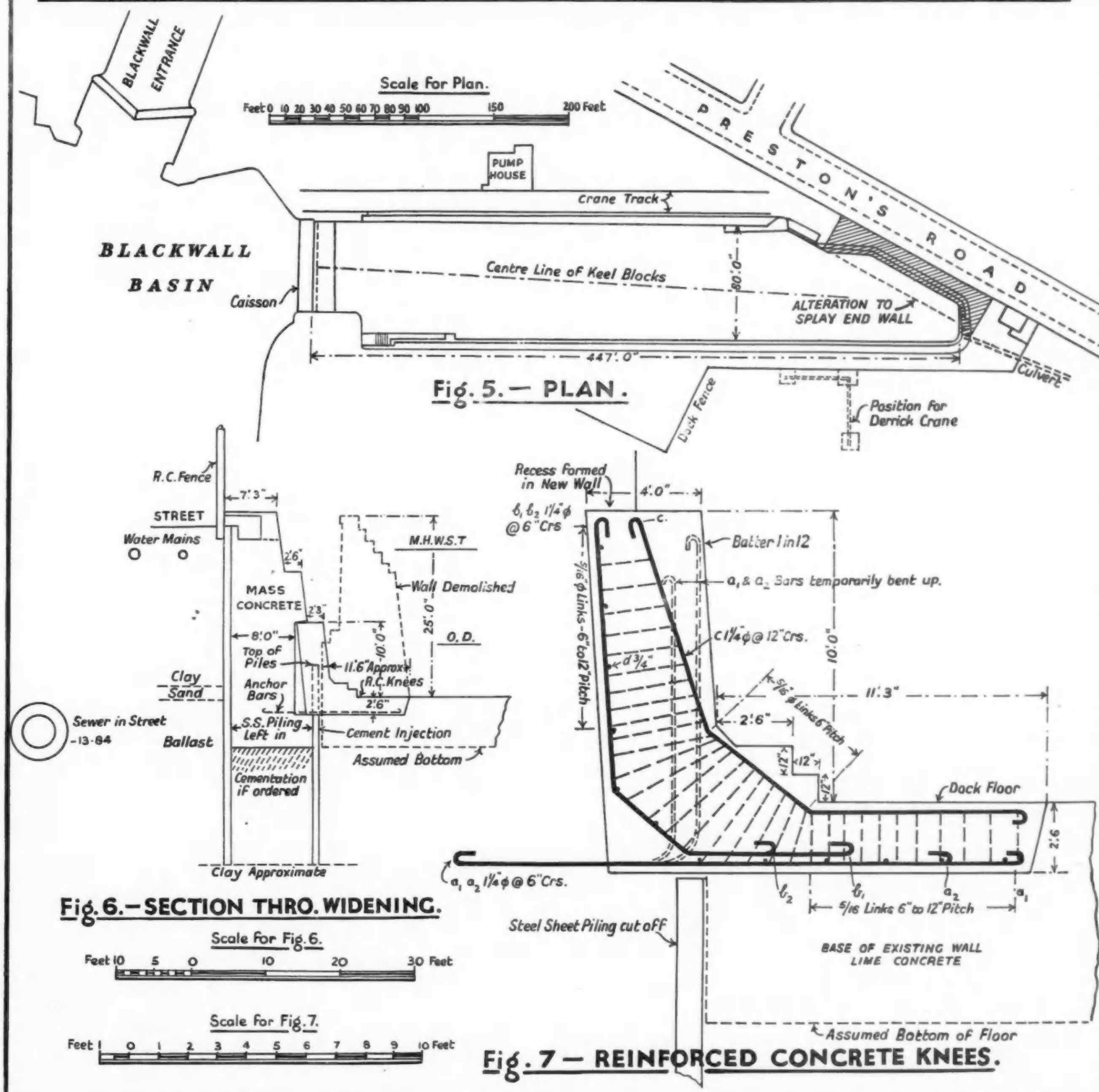


Fig. 5.—PLAN.

Fig. 6.—SECTION THRO. WIDENING.

Fig. 7—REINFORCED CONCRETE KNEES.

Dock Co. decided to widen the dock adjacent to Prestons Road to the extreme limit possible. This alteration is shown in Fig. 5 and provides working space around a vessel occupying the full length of the dock.

Borings indicated gravel with running sand from 21-ft. to 48-ft. below the surface and then a hard blue clay, the gravel, freely water bearing, was over laid with river mud and made ground which was imported clay puddle next to the wall.

Prestons Road contains the water, gas and sewer services for the Isle of Dogs and carries heavy vehicular traffic.

To ensure adequate support to the road and the services therein at all stages of the work, the new dock wall had to be built in two portions, the first, next to the road to its full height, within a box trench of steel sheet piling driven down to the hard clay. After driving No. 3 Larsen piles along the road boundary, the trench at the back of the wall was excavated to a depth of 14-ft. from which trial holes were put down to locate the lowest offset in the wall, Larsen No. 2 piles were driven as near to the offset as practicable in 28-ft. lengths and finally driven with a dolly until the toes reached the clay. As the steel piles available were in 42-ft. lengths, two half-lengths were used alternately with a full length of 28-ft. The excavation within the box trench to a depth of 33-ft. was heavily timbered with six settings of struts 9-ft. apart and double steel channel walings. The back of the wall was irregular and the space between it and the sheeting varied from a few inches to 1-ft. 6-in. The 6 to 1 mass concrete, deposited in 4-ft. layers, was carried up to the full height with a recess formed up to the level of the first altar, about 10-ft. above floor to receive reinforced concrete knee blocks to complete the full section of new wall after demolition of the existing.

East and West India Graving Docks—continued

The arrangement of the reinforced concrete knees is shown in cross-section Fig. 6. The mild steel anchor bars were built in the mass concrete and temporarily bent upwards inside the sheet piling, the piling in way of the tie bars being finally cut off at the underside of the knees.

When the bottom of the box trench was sealed by the first layer of concrete, the steel piling was holed at that level and pipe nipples, 5-ft. apart were welded on, through which neat cement grout was injected all around the trench.

The whole length of the existing wall was demolished down to the first altar at which the new section of wall was strutted. As no interruption to dock working could be permitted, the inflow of water had to be kept well within the capacity of the dock drainage pumps. An attempt to seal the gap between the steel piling and the foundations of the old wall below the knee level by injecting neat cement grout through drilled holes proved unsuccessful in stopping the inflow of water from the gravel, owing to the presence of fine loamy sand. The drilling of holes in the lime concrete was also unsatisfactory, the holes usually collapsed due to pockets of loose material in the wall, an alternative method had therefore to be devised to staunch the inflow.

The old wall below the first altar level was demolished in short sections sufficient to get in a knee block 9-ft. 6-in. long, commencing at both ends, the unstrutted length of new wall thus limited to two knee block lengths. As each knee position was cleared for the reinforcing bars a sub-drain was laid in the gap between the sheeting and the old work leading to a sump at each end. The water was sufficiently controlled by this means and a dry bottom obtained.

The steel reinforcement in the knee blocks as shown in Fig. 7 was assembled in cage form as a complete unit and lifted into position after straightening out the anchor bars to be linked up.

Grouting pipes were built in and the sub-drain filled with neat cement grout under pressure after all knees were concreted, the grout was mixed in the proportion of 112 lbs. of cement to 12½ gallons of water.

All steel piling was left in except the portions cut away for the reinforced concrete knees. Poker vibrators were used throughout for spreading and consolidating the mass and reinforced concrete and for working it to a fair face against steel shuttering. The shuttering had in consequence to be specially strutted against the increased pressure due to vibration and the height of concreting lifts limited.

The brickwork facing to the old wall 18-in. thick, with occasional bonding counterforts, was particularly sound and watertight, the lime concrete backing was very variable in quality, pockets and beds of gravel without any binding material were frequent, this was especially so towards the back of the wall against settings of poling boards found intact. Staging timber, evidently used for bricklayers, were frequently found embedded in the lime concrete which deteriorated towards the base of the wall and became softer in patches below standing water level.

At the two wing walls, the brickwork was trimmed back and refaced with concrete, bonded to the old work by steel holdfasts, infiltration from the pockets of gravel could not be staunched by grouting and weep pipes had to be inserted where seepage occurred through the concrete facing.

The above works were carried out without any interference to ship-repairing in the dock, it having been arranged by the Dock Company for long repair jobs to be selected so as to minimise stoppages to the work when flooding the dock.

Both contracts were undertaken by Messrs. George Wimpey & Co., Ltd., Civil Engineering Contractors, London, to whom we are indebted for the photographs.

The International Association of Navigation Congresses

Review of Papers Presented at the Lisbon Congress, 1949

The XVIIth Congress of the Association was held this year in Lisbon and the general reports upon the subjects dealt with having been recently circulated to the members, we are privileged to print information contained therein for the benefit of our readers.

The questions considered, and upon which communications were invited, were divided into two sections: Inland Navigation and Maritime Navigation. Both sections cover a wide range of studies and the papers—lengthy, informative, up-to-date, and fully illustrated with plans and drawings—are reported upon generally and in the form of synopses by eminent continental engineers.

Owing to space restriction, we are able to publish only abridged versions of these reports in this and succeeding issues of the journal. We hope, however, to reproduce in future issues selected papers which we consider to be of general interest.

The folowing is a list of the subjects reviewed.

SECTION I.—INLAND NAVIGATION.

Question 1	Acceleration of transport on Inland Navigable Waterways (13 papers).
Question 2	Means of dealing with large differences of head (6 papers).
Question 3	Functions of storage reservoirs (6 papers).
Communication 1 ...	New development in design and construction of locks (15 papers).
Communication 2 ...	Protection of embankments and bed in waterways (6 papers).
Communication 3 ...	Economic value of inland waterways (6 papers).

SECTION II.—OCEAN NAVIGATION.

Question 1	Improvement of Estuaries (10 papers)
Question 2	Oil handling (9 papers).
Communication 1 ...	Coast erosion (9 papers).
Communication 2 ...	Concrete in sea-water (8 papers).
Communication 3 ...	Traffic routes across canals (8 papers).
Communication 4 ...	Waves in harbours (10 papers).

First Question.—Acceleration of Transport on Inland Navigable Waterways

1.—Importance of acceleration of transport, having regard to the rate of freight and to the particular role of inland navigation.

2.—Measures to be taken for accelerating transport:—

(a) Measures concerning construction and operation of navigable waterways and inland ports (e.g. lighting of the waterways; towage);

(b) Measures concerning technical construction of craft and of their motive power;

(c) Measures concerning commercial operation of the navigation. Organisation of staff and plant services;

(d) Classification of navigable waterways with a view to the traffic of ships of uniform dimensions;

(e) Possibility of international standardisation of the measures above in the different States whose systems of navigable waterways are interconnected.

Experience resulting from the war.

GENERAL REPORT BY R. GRAFF

Ingénieur en Chef des Ponts et Chaussées,
Director of the autonomous port of Strasburg,
Delegate to the Central Rhine Commission.

Consistency of the Individual Papers

The Belgian paper by M. Charbonnier stresses the advantages of accelerated waterborne transport, partly to clients of a waterway, to whom it represents an improvement of the services rendered, and partly to the carriers themselves whom it enables to cope with an increased volume of traffic by a given number of craft. This latter advantage usually means a lowering of freight rates, by which the customers also benefit indirectly. But these effects do not always make themselves felt integrally or immediately. In Belgium, for instance, they are influenced by administrative interventions, the object of which has been since the war to co-ordinate the régime of chartering and freight-rates.

The paper presented by Messrs. Boereboom, De Rudder, Valcke and Van Cauwenberghe mentions, in particular, progress made

International Association of Navigational Congresses—continued

in Belgium towards motorisation of craft, especially those of the "spits" type, a progress at the cost of a certain disorganisation of towage services. It recommends an improvement of the layout and profile of the navigable waterways and of the dimensions of locks, their electrical and telephonic equipment, and standardisation of signals. It draws attention to the advisability of a rational disposal of inland ports, of a reduction of all unproductive stops, and also of a perfecting of the commercial working of navigation. Finally, it suggests the classification of navigable waterways in four categories, viz., suited respectively to vessels of 2,000, 1,350, 600 and 300 tons.

The Spanish paper, drawn up by M. Fernandez y Fernandez, describes the principal navigable waterways of his country, which are the Aragon Imperial canal and the Castille canal, which are of historic interest but whose traffic is considerably reduced nowadays, and above all the Guadalquivir, which serves the port of Seville and which it is proposed to render navigable by canalisation as far as Cordoba.

The United States paper, by Messrs. Rademacher, McCorkle and Newsom, had been drawn up already in 1939; it thus unfortunately does not take into account the progress made in their country during the past ten years, which has certainly been very great in the realm of inland navigation, as in all other ones. It nevertheless contains some very interesting data concerning inland navigation in the U.S.A., which in many respects differs a lot from what we are used to in Europe. Thus, it is a current practice in their country to use trains of barges, consisting of several barges of rectangular form coupled together side-by-side; these trains are pushed by a tug placed behind the convoy and which it would be more exact to call a "propulsor".

The paper mentions the steps already taken or proposed to accelerate the running of boats. Taken as a whole, these measures do not differ much from what is proposed in Europe. Nevertheless, the American paper stresses more particularly the saving of time that can be achieved in handling at the termini, viz. loading and unloading boats by a more rational layout of ports and the perfecting of their plant.

The French paper by M. Deymié makes a point, in the first place, of pointing out all the advantages that will result from accelerated inland navigation transport, the slowness of which is the principal defect. Placing himself in the position of the owner of a vessel, the author stresses the influence upon the time taken to turn round, of loss of time due to terminal operations after each voyage (unloading, looking for cargo, loading). He states that, for a given navigable waterway and craft, the effort should be directed above all to reducing all waits.

The paper next points, in a very detailed manner, to measures concerning the layout of navigable waterways and the construction of vessels that are likely to speed up the running of the latter, and the use that has been made of such measures already in France. It mentions in particular the development in that country of mechanical traction on the banks, which is done either with electric tractors running on rails or on pneumatic tyres or else Diesel tractors on pneumatic tyres. It states that this kind of traction, which is not much used in other countries, has given good results, without being opposed to an increased use of self-propelled boats.

There are two British papers, the first by Mr. Marsh and the second by Mr. Wilson. Both stress the particular features of navigable waterways in Great Britain, consisting on the one hand of river estuaries, sometimes prolonged inland by sections of canalized rivers, but which are always short distances, and on the other hand of canals of a small gauge. The transport capacity of these waterways is therefore small.

Consequently it is not astonishing that the measures suggested for accelerating transport mainly concern an increase of the dimensions of the navigable waterways and of their works.

The papers then discuss the various propulsion-systems of boats, the possibility of improving the construction and functioning of locks (advocating, in particular, the use of raisable gates) or the replacing of them by boat-lifts, and finally deals with matters concerning the lighting of waterways, movable bridges and subways (tunnels). The second part of the paper deals more particularly with the construction of boats and their propulsive means.

The Italian paper by M. Gorio, after having pointed out the consistency of the Italian navigable network essentially based on the Po valley, and the damage which it suffered during the war, stresses the necessity of first repairing this damage and then finishing the arrangement of the network, interrupted by the war. It describes the most suitable constructional methods for doing this.

The paper next deals with questions concerning dredging, beaconing, equipment of ports, navigation by night, types of boats, commercial organization. Finally, it mentions that the programme for arranging the Italian navigable network suggests three classes of waterways, suited respectively for craft of 600 t, 300 t and 100 t. This network has no possibility of being joined to other European networks.

The Dutch paper is framed by Messrs. Hanrath, Schippers and Thomese. It first discusses the repercussions of accelerated transport on transport charges and expresses the opinion that acceleration generally has little direct effect upon freight rates. It even admits that in certain instances the increased speed, by motorisation of boats for instance, may justify increased freight rates.

It then discusses measures to be taken for bringing about an acceleration of transport, such as the layout of navigable waterways, characteristics of locks, dimensions of channels, lighting and signalling, organization of towage, etc. As regards the construction of boats, it mentions in particular the new Dutch Rhine tugs, having a very small draught, and fast boats for passengers and cargo, which carry on regular services between Rotterdam and Bâle.

From a commercial standpoint, it points out the danger of unemployment that may arise from accelerated turn-round of boats at times when traffic is scarce. And finally it states that the Netherlands navigable waterways are actually subdivided into five classes and that the present standards take into account exchanges that are already made on a large scale with neighbouring countries.

The Swiss paper is by Messrs. Jacquet and Schaller. It refers essentially to Rhenish navigation as far as the port of Bâle, which has become of considerable importance to Swiss economic life because it amounts to about 30% of the tonnage of all foreign trade of that country. The factor of rapidity of transport intervenes here above all from the standpoint of competition with foreign railways and plays an essential part in this competition. M. Jacquet states definitely that any acceleration of Rhenish transport renders a lowering of freight rates possible, but of course within reasonable limits. M. Schaller mentions the steps taken by the port of Bâle to avoid or suppress loss of time.

There are two Czechoslovakian papers. The first, by M. Hanus, describes a system devised by the author for accelerating the speed of boats by means of haulage by a movable aerial cable suspended above the waterway. The paper places on record the advantages of this system, called a "boat ropeway," over other methods of propulsion such as self-propelled craft and traction from the banks, particularly as regards speed, which could be about 8 km. p.h. He explains how locks would be negotiated, including passing from a lock to the open water. According to additional notes by M. Hanus, this system has not yet been tried out in actual practice, but it is under consideration for the planned Oder-Danube junction canal.

The second paper is by M. Cabelka and is devoted to a study of the optima conditions to be created for the construction of a lock adjoining a river barrage.

Commentaries Inspired by the Papers

The advisability of accelerated transport over navigable waterways is not denied by anyone. Slowness has, in effect, always been the principal if not sole defect of this method of transport. This is truer than ever at the present epoch, when the factor of "time" plays an ever increasingly important role, to such an extent that, on even inter-oceanic routes, liners find it difficult to compete with aeroplanes. In the transport of goods, as in that of passengers, but to a lesser degree, "time is money" because merchandise represents capital which remains unproductive for the period of transport.

In his turn, it is of advantage to the carrier that his boats should

International Association of Navigational Congresses—continued

effect the largest number of voyages possible over a given lapse of time, say a year. For the expenses which he has to bear comprise fixed charges, independent of the number of miles travelled, which it is in his interest to spread over the largest possible number of voyages, in order to reduce the cost-price per kilometric ton. In the case of free competition, he can pass on to his customers part of the saving thus effected, viz. lower the freight rates and keep the remainder as profit, and eventually benefiting his staff by giving them an "output premium." A lowering of freight rates places him in a better position as regards competitive means of transport and thus helps him to find new customers.

When freight rates are fixed officially, as is the case in many countries since the war, acceleration of transport does not react upon them immediately, and only if such acceleration is of a sufficiently widespread nature, but boat-owners nevertheless profit in turn.

It is recognized that, apart from measures of a technical or commercial nature that are likely to accelerate waterborne traffic, keenness to work on the part of the bargeman will considerably shorten voyages on canals, notably by suppressing many losses of time which, taken individually, do not amount to much but do count when accumulated. That is why craft owned by the boatman himself usually travel faster than others steered by paid hands; it is artisan-proprietors of self-propelled boats, which are comparatively expensive, who are in a hurry to complete trips.

In the realm of construction and operating of navigable waterways, many measures are capable of having a favourable influence upon the speed of transport. We would mention, in the first place, an improvement of the plan layout of a waterway, e.g. suppression of certain bends; but cases where this can be done without entailing expenses disproportionate to the saving that will be made are rare. The replacement of two or more locks adjacent to one another by a single lock with a big head can be more frequently undertaken. An increase of the cross-section is often worth while to reduce resistance of the water and consequently increase the speed of boats on reaches; if the outlay be the same, an increased depth is usually more profitable than an increased width. Nevertheless, one should never lose an occasion of suppressing narrow passages, especially beneath bridges.

Technical progress and methods should reduce traffic delays to a minimum, even if it entails enhanced expense, or else the work done preferably at night time. Dredging liable to hamper traffic should also be done at night, as far as possible.

Mechanisation of the working of locks and movable structures are capable of appreciably speeding up traffic. Hydraulic gear can be used, or else electric motors; this latter process is the one most often chosen; it is much the most simple for isolated structures of slight or medium importance. On a given navigable waterway the right action is to commence by electrifying—if there are any—locks that are the most difficult to surmount, e.g. those having a large head. If all locks are roughly comparable, it is desirable that they should all be electrified, especially if traffic is intense, otherwise there is a tendency to traffic-jams close to the first non-electrified lock. The resultant losses of time will offset time saved in passing through electrified locks. We might, moreover, point out that electrification of locks and movable bridges has a further social benefit, as the lock-keeper's job is much less fatiguing.

As lighting of the navigable waterway and especially of locks makes it possible to navigate by night, it is capable of considerably increasing the average speed of boats. The advantage it procures is, however, less than what might be thought at first sight, as it is almost impossible to navigate a boat day and night; to do that it would be necessary to have two or three shifts, and there is seldom space to house them on board. But lighting of waterways enables in any case, without increasing the number of the crew, boats to ply longer during the winter, when the days are short.

And finally, there is one improvement of waterways which is of great importance to the speed of craft that are not self-propelled; we refer to organization of mechanical traction. It appears that France is the only country which has attempted to solve this problem on a large scale by installing mechanical haulage on canal banks, either by electric tractors running on rails or by electric or Diesel tractors running on pneumatic tyres.

Another system of mechanical traction consists of using "boat ropeways," mentioned in the paper by M. Hanus.

Most of the reporters lay stress on progress achieved by motorisation of boats, although on waterways where there is a well organised system of mechanical traction the speed of self-propelled craft is hardly greater than that of hauled boats. But a self propelled craft has the advantage of being able to travel anywhere, without having to depend on a traction or towage service; but this advantage is only acquired at the expense of high constructional cost.

As regards the shape of hulls, progress has also been made and further improvements are possible. It should be remembered, however, that on canals the speed of boats is often restricted by regulations; in this instance streamlined vessels do have the advantage of requiring less tractive effort for one and the same speed. But it is above all on rivers having a free flow that well conceived lines for the hulls of vessels give appreciably higher speeds, as witness the Rhine in particular.

The construction of tugs has also undergone rapid development in recent years. On the one hand, steam engines have a tendency to be replaced by Diesel engines, which enable greater power to be developed whilst requiring less hands in the engine-room. Propulsion by paddle wheel tugs is now abandoned and replaced by propellers enclosed in shields, such as are now adapted to powerful vessels which can navigate in very shallow water (about 1,20 m. for a 3,000 H.P. tug). Use is also made of propellants having a vertical axle, which give very good results but are more fragile than propellers. The displacement of tugs can thus be lessened from more than 20 m. to less than 10 m. beam, which is very important for passing through locks, the arches of bridges and so forth.

As to commercial management of waterborne traffic, the intervention of the public authorities has made itself felt in many countries before and since the recent war. Its aim, above all, was to ensure division of traffic between the various proprietors or operators of vessels and to avoid boats lying idle in certain districts when they could be used elsewhere.

As regards private owners, the necessity of competing (with the railways, for instance) or the damage caused by the war (destruction of an important part of certain fleets) sometimes caused boat-owners to adopt interesting measures for rationalisation of their management. We might mention in particular the forming of groups of private owners or the owners of tugs as co-operatives or joint-managements, like the one which to-day groups all the French Rhenisch shipowners.

Few of the papers mention any new knowledge gained from the war. That is no doubt because inland waterways in the countries at war were carrying goods that were not strictly for military requirements, or at any rate unlike what they usually carry in peacetime, with the result that, unlike aerial or maritime navigation or even road transport, they did not receive any special solicitude from the belligerent States such as would increase their traffic or capacity.

To conclude, we should like to stress the case of one navigable waterway that is particularly important on account of its traffic: the Rhine. This river flows through the territory of four States and its estuaries place it in communication with a fifth. An advantageous situation, without a doubt, because it predestines it for international transport, but also a dangerous situation because a lack of agreement between these five States might almost paralyse its entire traffic. Fortunately this agreement exists and makes itself manifest at the meetings of a permanent international commission called the Rhine Central Committee, created in 1815, and the statute of which was confirmed by a Convention in 1868 and finally by the 1919 Peace Treaty. The existence of this Commission, whose role it is to watch over freedom of navigation on the river and equal rights for the subjects of the countries concerned, has a certain repercussion on the rapidity of Rhenish transportation. Every effort is made to see that the latter is not hampered by administrative regulations which so often interfere with international trade. Furthermore, the Commission takes care that, technically, navigation on the river is not slowed down by works of insufficient dimensions or by a lack of maintenance. It draws

International Association of Navigational Congresses—continued

up and keeps up-to-date the regulations that apply to the whole river. Its role was predominant after the war to hasten restoring of navigation and then to more and more improve the channel that had been freed, and finally to restrict or prevent impediments resulting from the war as regards the circulation of human beings, of food supplies, the repairing of vessels, etc. On a limited scale, that is a fine example of what can be done, for the common weal, by a well balanced collaboration of several countries, whose interests are, however, far from being identical in all branches, provided they are wise enough to renounce, in the common interest, certain prerogatives that are not indispensable to their individual sovereignty.

Conclusions

It is difficult to draw from treatises concerning such a wide question conclusions that are both concise and sufficiently general. From the foregoing commentaries one can judge that the problem of acceleration of transport on navigable waterways can have no general solution because traffic conditions differ enormously from one country to another and from one navigable waterway to another.

We feel, however, that by way of conclusion we ought to lay particular stress on the following points:

1. Inland navigation cannot continue to play an important active role in the modern organization of transport unless it attempts to shorten the long waits that so often occur in waterborne traffic. The advantage of this kind of transport being its cheapness, acceleration must not be achieved by too costly means and must therefore remain within reasonable limits.

2. Acceleration of waterborne traffic is conditioned to a large extent by suppression or reduction of loss of time from sundry causes, which mount up during the course of a voyage, especially: looking for freight, loading, the start and finish of each day's travel, the passing of certain works or difficult spots on the navigable waterway, and unloading.

The managements, those entrusted with construction and maintenance of navigable waterways and ports, and above all the boatmen and shipping owners themselves, must do all they can to lessen loss of time.

3. Increased speed of vessels themselves clearly means a lot in any acceleration of transport. Motorisation, the installing of electric traction, improvements to tugs, should all proceed concurrently to achieve the purpose.

Second Question.—Means of Dealing with Large Differences of Head

1.—Comparison of the various possible solutions concerning the construction and water-consumption from the technical and economical standpoint. Works constructed and contemplated.
2.—Operation results.

GENERAL REPORT BY MR. ALBERTO ABECASIS MANZANARES

Professeur à l'Institut supérieur technique de Lisbon.

The constantly increasing need in several countries of producing electric power and the more intensive use of waterways for this purpose, by building hydro-electric plants consisting essentially in more or less high barrages—and thus creating a difference of head—or storing reservoirs, or both of them simultaneously, puts the problem of the best way for navigation purposes of dealing with the large differences in head involved.

However, this problem exists in many mountainous countries independently of the installation of hydro-electric power stations.

The means of dealing with large differences of head, which are mentioned in the different papers, may be classified into:—

(1) Locks (basin and well locks, single or double, with or without " water saving basins " and forming, or not, flights of locks);
(2) Vertical lifts (floating, with counter-weight or funicular);
(3) Sloping planes or slipways (with transport of the craft, dry or floating).

Three new models appear in the papers, which have been presented to us: the Polish author, Mr. Tillinger, presents a new type of lock or lift with pneumatic operation, in which the water would be replaced by compressed air; in the Czechoslovakian paper, Messrs. Zaruba and Pfeffermann inform of a new type of hydraulic, suspended and compensated lift; and the American paper describes a type of crane or lifting apparatus, planned to overcome the barrage of Bagnell with small crafts, up to 100 tons. Opinions about the use of such means—excepting the latter, which seems perfectly viable and even advisable in the given conditions—must be reserved till experiences on a sufficiently large scale, or the execution and operation of any work of the indicated type, will have undisputedly corroborated the expected working and theoretical advantages.

Thus only remain for analysis the classic means of dealing with large differences of head: locks, lifts and slipways, more or less perfected in order to improve their advantages and lessen their inconveniences.

When choosing a type of device, we may consider the following factors as predominant, yet of variable relative importance:—

1° Water consumption, in connection with its more or less great abundance and the necessity or convenience of its use for other purposes.
2° Importance of the traffic and its probable development, in regard to the water consumption and the durations of passage, which will have an influence on the saturation of the adopted device.
3° Topographical and geological conditions, with a radical influence on the costs of works, their foundations and their approaches.
4° Costs of the works—essentially influenced by the difference of head to overcome—and costs of their operating.
5° Security of the operating and detriments caused by possible interruptions of traffic.
6° Variability of upstream and downstream water levels, which might influence—in waterways with a certain importance and submitted to considerable floods — the formation of solid material deposits, and thus endanger the working of movable parts.

The operating of the locks is connected with a more or less important water consumption, which leads very often to the use of arrangements enabling to reduce this consumption (water saving basins, double locks). Such arrangements call for more available room, add a serious burden to the first erecting costs and increase the duration of the passage manœuvre.

When the difference of head is due to the existence of an hydro-electric plant, the consumption of water may become very important. It is possible to calculate its economical estimate, in regard to the equivalent energy which has not been produced.

The recourse to flights of locks, which seems at first sight indicated in dealing with large differences of head within a relatively small reach, presents several inconveniences:—

(1) It is not possible for crafts to pass each other within the flight of locks, when these latter are superposed; each upward going craft will have to wait until downward coming boat has passed through all the chambers, before being able to use the flight itself, and reciprocally.
(2) For isolated upward going crafts, the water consumption is nearly the same as this for one single lock overcoming the total difference of head.
(3) The surface occupied by a flight of n equal locks is n times greater than that occupied by one single lock overcoming the same difference of head (provided that no use is made of water saving basins), which, in certain cases, may lead by itself to reject the choice of a flight of locks.
(4) It takes a longer time for a craft to pass through a flight of locks than through one single lock with the same total difference of head, since, even at equal rising or falling speed of the water, a supplement of time is needed for the passage of intermediate gates.

As the costs of works are intimately tied to the geological and topographical conditions, it is not possible to define them immediately.

As for the working or operating security, there is no doubt about the real superiority which the lock presents, compared with the other systems; the different presented papers show, however, that there is no reason to complain about the working of the other types of works already operating.

International Association of Navigational Congresses—continued

In connection with the consumption of water, and if there are no sufficient discharges available, one might, if one disposes of ample resources of energy and if only the problem of navigation interests is in question, pump the water from the downstream to the upstream reach of the lock—instead of building this lock with a water saving basin—thus reducing the costs of the work and the passage duration of crafts. This would be a nonsensical solution in case of a lock adjacent to an hydro-electric plant.

When locks are used for dealing with large differences of head, important hydraulic problems arise, which may generally be solved by laboratory tests.

The presented papers mention several locks already operated, as well as other ones still being built or designed, with considerable dimensions, such as the Donzère-Mondragon lock on the Rhone, with a difference of head of 25 metres, the Bonneville and Pinopolis locks, in the United States of America, with 65 and 75-ft. respectively, and the Stechovice lock, with 20.1 m.; all these are locks where the problem of the water consumption is not, at the present time, predominant.

For greater differences of head, special devices are designed, such as the lift connected with a level variation chamber, which is anticipated for Slapy in Czechoslovakia and which will have to deal with differences of head of between 55.4 and 55 metres; the lift anticipated for the Norris Dam, Tennessee, for a height of 256-ft. and 1,000-tons crafts, or the sloping plane or slipway designed for the Bagnell Dam, for 500 tons and a difference of head of 110-ft. One should also mention the arrangements anticipated for Génissiat, where a difference of head of 65 metres must be dealt with, and where a choice will be made between a lift, a funicular railway, a well lock sunk in the rock or two locks separated by a small canal for boats passing each other; the solution of this case is facilitated by the fact that there is no problem of water consumption. In Belgium, too, at Ronquières, a comparative study has been made of the solution with one or two lifts, or with three locks of 18.61 m., for a total difference of head of 55.83 m.; no choice has been made as yet about the solution to adopt.

Third Question.

Function of storage reservoirs (in main or side valleys), in regulating flow of water, whether canalised or not, in reducing flood waters. Case of water used for power. Study of models.

GENERAL REPORT BY ALFONSO ZUZARTE DE MENDONCA

Ingénieur-Inspecteur Superior des Travaux publics, Lisbon.

Regularisation of a river basin for lessening floods and increasing its summer low water flow may lead to the use of multiple-purpose reservoirs. The advantages of the latter, somewhat contested for a certain while, are nowadays better known, thanks to American practice.

The "Handbook of Applied Hydraulics" by Davis classifies reservoirs as follows:—

(a) **Accumulation-reservoirs to serve a single purpose,** such as the production of electric power, irrigation, supply of drinking water, regulation of the discharge of a navigable waterway.

(b) **Single-purpose flood control reservoirs.** These must be able to be rapidly emptied after each flood, without exceeding the capacity of the evacuation-channel. This type comprises reservoirs with constantly opened sluiceways (retarding basins); operated reservoirs (detention basins) which have appliances for controlling the emptying; and reservoirs having sluiceways constantly opened with auxiliary gates (retarding basins with auxiliary gate control). These gates enable a greater discharge to be obtained during the initial stage of floods, where desirable, and a more rapid emptying of the reservoir when the capacity of the evacuation-channel permits.

(c) **Multiple-purpose reservoirs,** planned and operated for two or more purposes. We exclude from this type reservoirs whose planning and operating are determined by a single function, although they provide other profits, added as by-products. (See "Proceedings of the American Society of Civil Engineers," March 1949, page 288.)

Messrs. Coquand and Cuq, authors of the French paper, state that in their country most river basins are regulated solely with a view to production of electric power. It is only the Seine basin that has as its main object the lessening of floods and the increasing of the low (summer) water. For economic reasons it also includes hydro-electric installations.

On the Rhone (Génissiat and Donzere-Mondragon) production of electric power is the main object, although regulation of floods and increasing the low-water flow have also been duly considered.

Messrs. Coquand and Cuq discuss two fundamental questions concerning the study of floods by means of reservoirs:—

1° To what extent can works planned for the production of electricity also function as flood-regulators?

2° What are the general principles for regulation of a river basin, both for floods and low water, without losing sight of the production of electricity?

The first of these questions conduces an examination of the utilisation, for combatting floods, of reservoirs constructed for other purposes.

It should be pointed out that, to use most efficiently the storage capacity kept in hand for lessening floods, filling should only be commenced after a certain flow is received. It is thus possible to obtain a greater reduction of the maxim flow. For this purpose one must have appliances possessing a large evacuation capacity, usually deep gates giving a large run-off even if the reservoir is not full, and sluices of a manœuvrable area or automatic.

On this first question, Messrs. Coquand and Cuq come to the following conclusion:—

"When a barrage-reservoir is provided with appropriate sluices, it enables floods to be appreciably lessened, especially if it is possible to effect either large running-off or suitable storage capacity."

Messrs. Coquand and Cuq explain the difficulties of the problems to arrange a river basin by means of multiple-purpose reservoirs. They stress antagonism existing between the various uses. In effect, for the production of electric power a reservoir as full as possible is necessary; for lessening floods the reservoir must, to a large extent, remain empty. A compromise is obtained by planning part of the capacity of the reservoir for the storage of usable water and another part for temporary absorption of flood water, during the season when the latter is dangerous.

The Italian paper by Professors Giandotti and Tonini and M. Marchetti points out that storage-reservoirs built in Italy are almost exclusively used for production of electric power. On December 31st, 1946, there were 116 of them, with a total capacity of 2.13 milliard cubic metres.

This paper reviews the various Italian watercourses and their characteristics in regard to five types of regimen and discusses the influence which the construction of reservoirs may have on each of these types.

It deals in particular with the Po basin, which is navigable over 317 km., from the confluence of the Adda to the mouth.

The total capacity of the natural lakes and artificial reservoirs situated in the Po basin is estimated at 2.8 milliard cubic metres, which represents only 3.4% of the meteoric afflux to the whole river basin (80 milliard of cubic metres).

The exploitation of this ensemble of reservoirs has no very appreciable influence on navigation conditions on the Po the depths only fluctuating by about 0.20 m.

The author of the U.S.A. paper, Brigadier General Young, states that his government, through the intermediary of the Corps of Engineers, is engaged on the biggest programme of reservoir building ever undertaken and aiming at suppressing floods.

As a matter of fact, the carrying out of these works only forms part of a general programme of regulation of floods, comprising other works such as workable reservoirs, embankments, floodable areas and alterations of channels, not forgetting as an accessory the improvement of navigation conditions and the production of electric power.

Up to 1930, in the U.S.A., when reservoirs were built the only objects were the production of electricity, irrigation and supply of drinking water.

(continued on page 176)

Model Experiments on the Belgian Ports of the North Sea

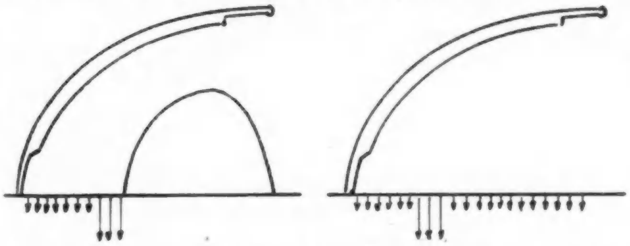
By L. BONNET & J. LAMOEN.

There are many divergent views expressed by engineers upon the values of experiments carried out on small scale models of ports subjected to the influences of manifold currents and barometric response. The pessimist takes the attitude that the distortion between horizontal and vertical scales of the model and the particle size of the alluvium, or solids in suspension, used in the model, throw all calculations out of gear with actuality. There is, of course, a certain amount of truth in this point of view, but not sufficient cause to distrust the practical conclusions drawn from the model results by experienced maritime specialists. Experts themselves may even differ on theoretical interpretations of observed phenomena, but that does not impair the observed experimental results of corrective measures attempted in the models. This point is corroborated by the most able and interesting account of the model experiments described in the June, August, October and December, 1948, numbers of the " Annales des Travaux Publics de Belgique " and later published together, in book form, under the title " Etude des Ports Belges de la Mer du Nord," by L. Bonnet and J. Lamoen and issued by the " Imprimerie G.I.G.", Brussels.

This book deals with two ports, Zeebrugge and Ostend, separated by a distance of twelve miles only, but presenting two widely different problems. The one, Zeebrugge, is a single curved mole enclosing a considerable area (179.5 hectares or almost 450 acres) of the sea and encroaching upon the natural flow of the currents along the coast line; the other, Ostend, is a canalised outlet debouching on the sea with little or no interference with the littoral currents.

The value of the work done on these problems by the Dutch and Belgian laboratories is of paramount importance to all Maritime engineers from the practical point of view. In the first place the methods of treatment in the Dutch and Belgian laboratories were different, and unrelated, but the results were much the same. Secondly, the problems were approached in a scientific manner, progressing from reproduction of actual behaviour in miniature to variations of remedial measures to obtain a certain objective in a simple direct way. Thirdly, the explanations were outstandingly practical, showing a complete grasp of maritime conditions, and an effective simplicity, which could only be derived from a wide experience of engineering concepts of the factors involved.

On these three features alone the experiments should claim the careful attention of all harbour engineers in all parts of the world. To do justice to this work one must follow step by step the arguments of the authors. In the preamble they discuss the formation of the ports of the Belgian coast, pointing out that they owe their shape and arrangement to the local sets of conditions of the coast line, the livelihood of the residents, and the types of vessels using them. The land is flat and devoid of any river outlet. The first



Figs. 1 and 2.—Project T14 and State To: Horizontal current flow towards the slit in coastal embankment.

type of port was therefore that of a narrow channel giving access from the sea to an inland harbour. Such a type was simple and not expensive to construct and maintain for the use of vessels of comparatively small tonnage. Such ports were Ostend, Nieuport, and Blankenberge.

The Zeebrugge Mole

The need was felt that Belgium must have a port on the North Sea capable of dealing with transatlantic vessels of high tonnage and high draught of water. This resulted in the construction of the Zeebrugge mole, a curved arm of substantial proportions enclosing an area of water from which locks gave access to the Bruges ship canal. The tidal range was 12.2 feet, and produced currents of 3 knots per hour. The sea bed was of fine sand, and the sea waters contained no less than ½ lb. of mud in suspension per cubic yard of water.

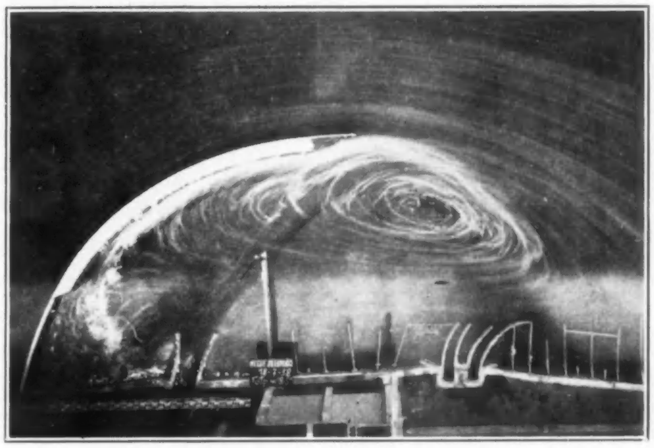


Fig. 3.—State To: Flood current.

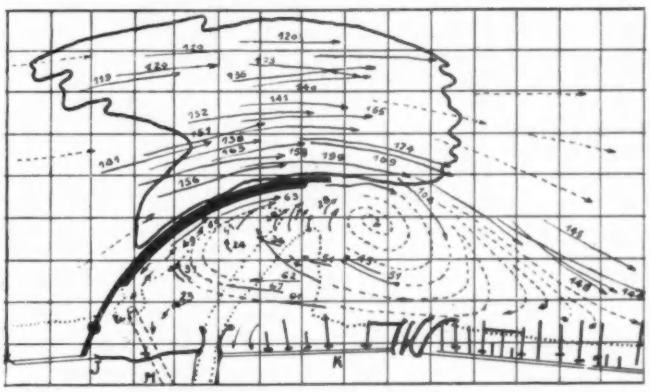


Fig. 3a.—State To: Flood currents. Velocities in cms/sec. natural.

Since the only currents here are tidal, the enclosed volume of harbour water provided a suitable settling medium for all the mobile and suspended solids in the sea water. Sand was not difficult to deal with by dredging, but silting, as maritime engineers are aware, is much more diffusive and objects to mechanical handling; as Dr. Van Veen once remarked, " where one drop of sea water may penetrate so also can a grain of mud." The pioneer engineers of Zeebrugge mole foresaw this difficulty, and therefore, with the intention of combatting the threat of mud deposition near the fairway, berthing, and manœuvring areas of the harbour, incorporated an open viaduct in the shore end of the mole. This was in effect a triangular weir and was first designed to be 1,320 feet long, but was decreased by 330 feet during construction. The total length of the mole from the root is about 7,800 feet with the head in 26 feet of water at low tide. The open viaduct commenced at about 750 feet from the root of the mole. In 1929 after much discussion by the experts it was decided to close this opening to the sea. It was then advanced that by reason of its shallowness the tidal currents passing through this opening over the wide harbour area were too weak to have the desired sluicing effect and it was impossible to maintain the depth of 26 feet at the head of the mole.

In the course of time a blanket of mud settled all over the harbour and several mud banks were formed in the turning basin. Conferences of engineers were held to find a solution. The opinions

Model Experiments on Belgian Ports—continued

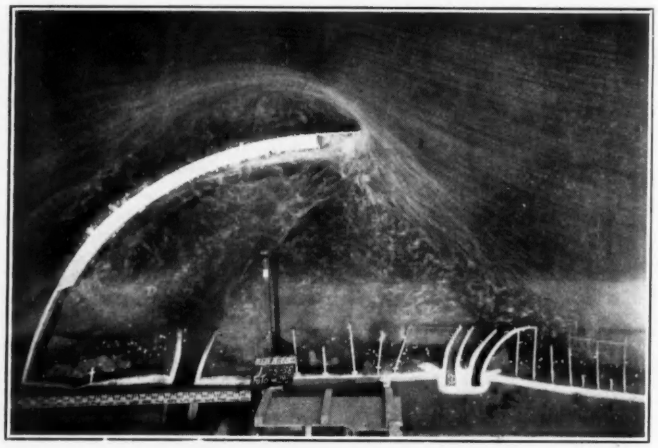


Fig. 4.—State To: Ebb current.

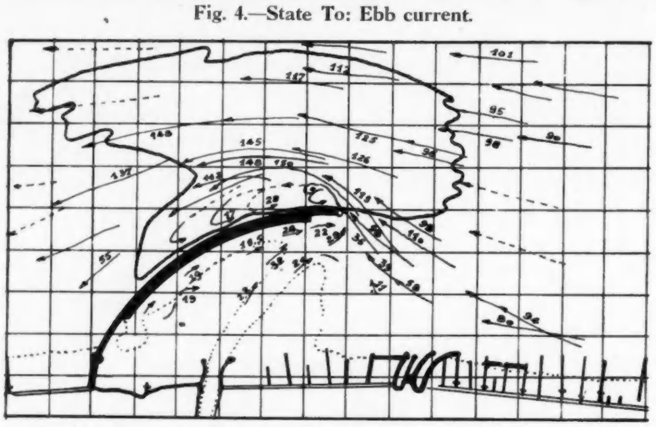


Fig. 4a.—State To: Ebb currents. Velocities in cms/sec. natural.

were so diverse the Belgian government decided to have the problem investigated by model experiments in the research laboratories. The first studies were entrusted to the Waterloopkundig Laboratium at Delft, Holland. The second was executed by the Laboratoire de Recherches Hydrauliques des Ponts et Chaussées de Belgique at Borgerhout, Antwerp. The book is more concerned with the latter series of experiments and the endeavour to find a suitable practical means of preventing the silting up of the harbour of Zeebrugge.

General Details of the Model

Although a large number of experiments were conducted, it will be convenient to classify them in two groups with the following notation:—

(1) with the open viaduct closed. T14, Lab. 3, Lab. 4, M2.

(2) with the open viaduct open. T*o* open, Lab. 8d.

The harbour form and neighbouring offing were based on the 1933 Hydrographic survey of the sea bed.

The water supply of the model was arranged with channels at the extremities so fitted with regulators that the desired level of flood or ebb could be maintained, and at the same time gauges measured the supply and draw-off of the water circulating to generate the current of the simulated tide. The water discharged from the model was collected in a reservoir in the basement and recirculated by a centrifugal pump. The basis for the water depths were founded on the records of the 1933 survey, and were:

Average tides, low, +0.58 m ; high +4.27 m.
Neap tides, low, +1.17 m ; high +3.58 m.
Spring tides, low, +0.09 m ; high +4.83 m.

Since the simulation of varying levels of water and the consequent variation of velocity and direction of currents during the rising and falling of the tides, apart from being most difficult to arrange experimentally represented a refinement not absolutely necessary to the purpose of the enquiry, it was decided to run the model at fixed levels of water and fixed currents in the flood and ebb respectively. This rendered the observations independent of time as it also meant a neglect of the slack water periods at the times of change of ebb and flow. To compensate for this a certain amount of water was removed or fed into the model in order to approach as near as possible to the real phenomena. The fixing of the linear scales of the model is always a matter for debate among the experts; but as, in the past, many successful model experiments have been carried out on widely varying scales the practical import does not seem to be of much consequence. More often than not the governing factor appears to be the floor area of the laboratory. In the Belgian experiments this was certainly the case. Here the horizontal scale was fixed at $1/n=1/650$, and the depth scale $1/m=1/64$ from which the distortion of the model is $650/64=10.16$. The Dutch model of Zeebrugge in the Delft laboratory had a distortion of $400/60=6.67$. Applying the Reech-Froude rule for model similarity,

the scale of velocity factor $=1/\sqrt{m}=1/\sqrt{64}=1/8$
the scale of the wetted sections $=1/mn=1/650 \times 64=1/41600$
the scale of time $=\sqrt{m}/n=8/650=1/81.25$.

It should be noted that despite these figures of recognised technical validity the authors considered that in order to realize in the model currents amply strong to transport the solids by suspension and rolling over the bottom an empirical scale of 1/4.4 was the minimum. This was adopted. They also felt justified in employing an experimental technique of expediency to overcome the difference of the natural behaviour of tidal waters and the fixed levels and velocities of the experimental run. The expedient took the form of the introduction, or withdrawal, of a certain amount of water to achieve the closest approximation to reality. For example on a rising tide the waters flow from the access channel through the maritime locks as well as through a horizontal slit established along the shore line from the root of the mole to the point K, 6,000-ft. to

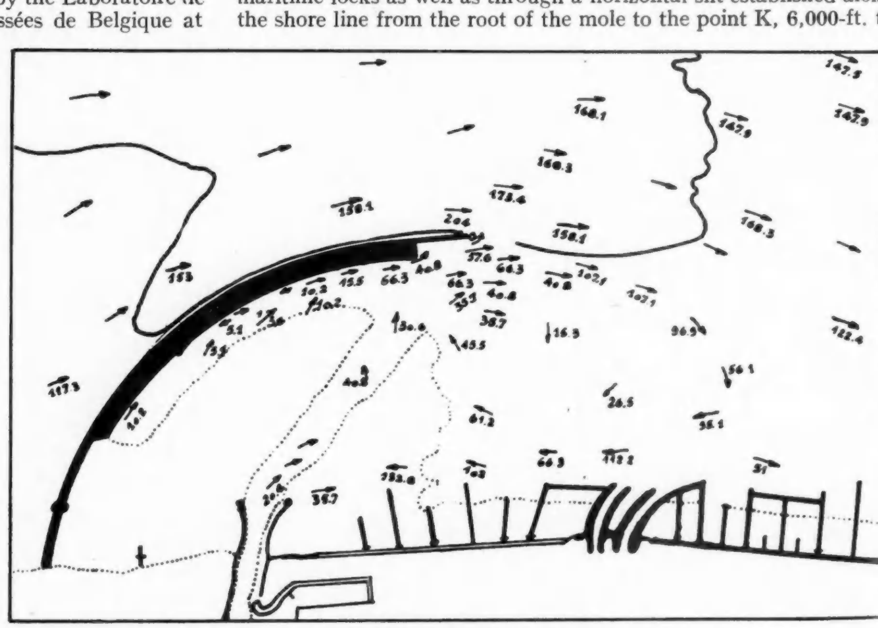


Fig. 5.—Actual velocities of the flood current in cms/sec.

Model Experiments on Belgian Ports—continued

east (see Figs. 1, 2 and 3a): the top edge of the slit is fixed at (+3.80m), the level of the flood waters; and the lower edge is fixed at (+2.50). A low embankment with top at (−1.00 m) is placed across the entrance channel to regulate the amount of water drawn in between the channel and the coastal embankment slit. Added to this there is a 2″ diameter pipe L.M. Fig. 3a connected to a small pump and with a sump situated at the extremity in the channel alongside the mole.

During the fixed ebb current the water level is maintained in the model at (+1.07 m) which is also that of nature, when the retreating currents of the harbour are concentrated in the channel alongside the mole, and to the one which leads to the maritime sluice. Thus, if instead of drawing off the water to the sump a certain amount is passed in, the same effect will result, for the supply will be divided between the channel alongside the mole and the channel from the maritime sluice to the sea. The authors are careful to point out that this device does not give an irreproachable similarity but it does achieve a close resemblance to the flow of the currents caused by the periodically recurring filling and emptying of the harbour by the rise and fall of the tides. To justi v the methods adopted they draw a most interesting comparison with the entirely separate experiments carried out by the Dutch at Delft on the same problems.

At Delft, the manipulation of the water supply, gaining and losing, was operated by a number of small diameter pipes feeding into the bottom of the harbour. The practical impossibility of realising true to nature characteristics of the currents through the model harbour caused them to give great attention to realise exactitude at certain essential points. Thus the efforts were directed to obtain close similarity at the mouth of the harbour where the critical changes take place between the sea and the sheltered waters. The Belgian experimenters claim for their methods of approaching natural full scale behaviour a closer resemblance by reason of the fact that the control of the model currents was horizontal, whereas with the Dutch methods of upward projected streams from the pipes in the harbour bottom an element of vertical velocity practically non-existent in nature was introduced. Nevertheless, in spite of the differences of experimental method the final overall results showed general agreement.

The mean velocity of the experimental current was fixed at 20 cms. per sec. after preliminary trials with muddy waters. Although this velocity in fact impeded the formation of deposits of mud in the model it was found convenient in view of the study of sandbank formation and the rolling of the solids over the sea bed. The wetted section of the model at the fixed high water (+3.80 m) was

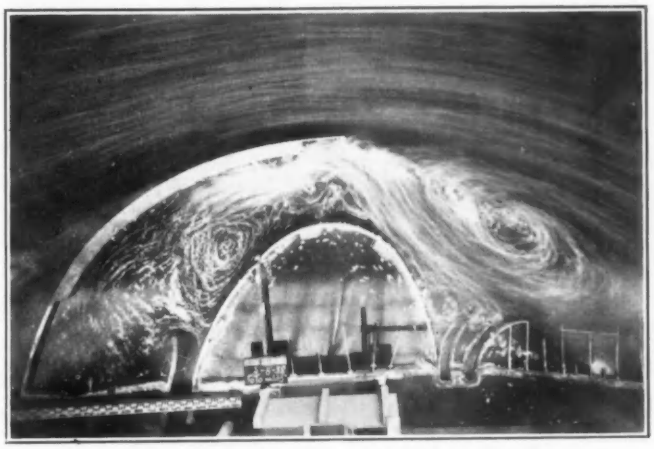


Fig. 7.—Project T14: Flood current.

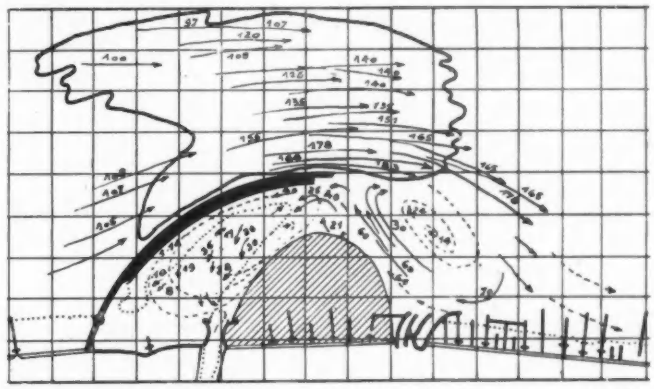


Fig. 7a.—Project T14: Flood currents. Velocities in cms/sec. natural.

81.56 square decimetres which at the velocity of 20 cms. per sec. required a volume of flow of $81.56 \times 2 = 163.12$ litres per sec. at flood tide. These quantities satisfactorily achieved a model reproduction of the actual currents shown in Fig. 5.

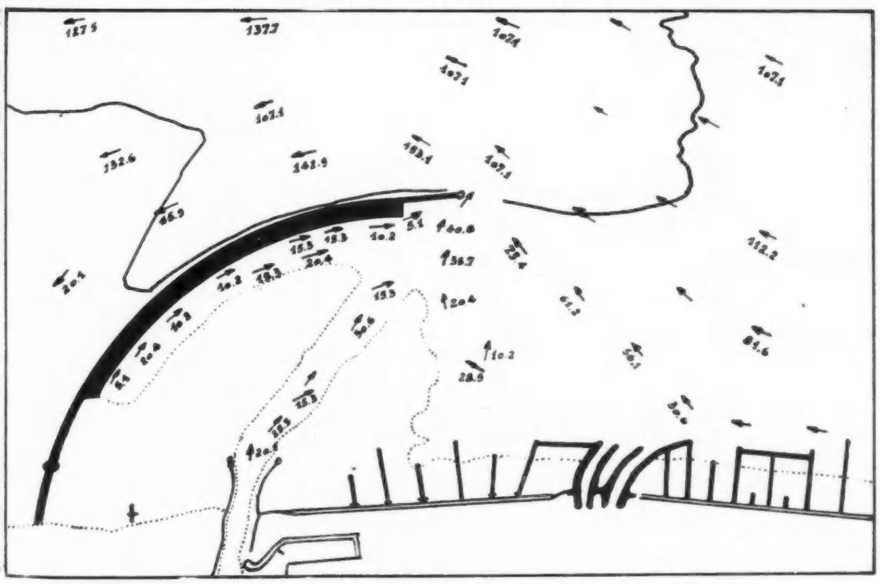


Fig. 6.—Actual velocities of the ebb current in cms/sec.

To fix the velocity of the ebb currents to agree in miniature with the actual harbour conditions shown in Fig. 6, it was found necessary to reduce the volume of water passing through the model to 112 litres per sec., and as the wetted section at low water was 58.57 square decimetres at the fixed low water level of (+1.07 m) the mean velocity of the ebb current was $112/58.57 = 19$ cms. per sec., which is satisfactory for the experiments on silting.

Experiments with Clear Water to Verify Currents in Actuality and in Projects

The first care was to verify that the preliminary dispositions were satisfactorily reproduced in the model to generate the patterns of currents shown in Figs. 5 and 6 for the flood and the ebb. The surface of the water was streaked with confetti and in the run photographs were taken. Naturally the first test was on the harbour and coast arrangement as it actually was; this was test T*o*. It will be noted that Fig. 5 shows by the inclination of the current arrows the presence of a large eddy to the east of the mole and

Model Experiments on Belgian Ports—continued

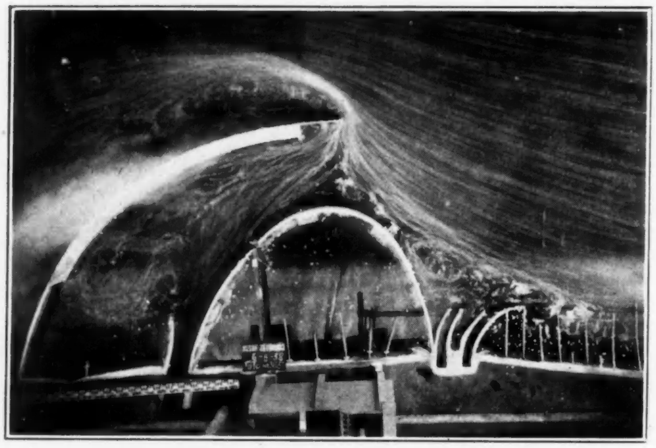


Fig. 8.—Project T14: Ebb current.

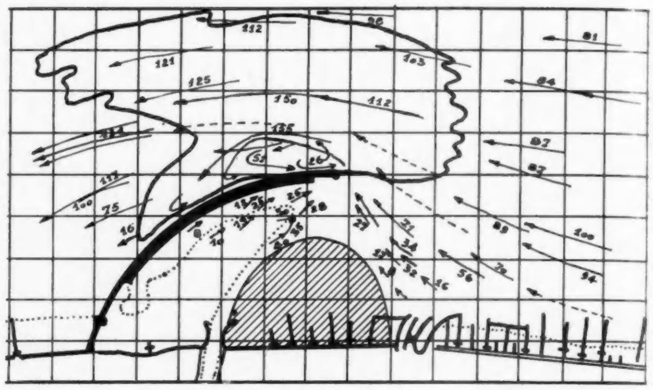


Fig. 8a.—Project T14: Ebb currents. Velocities in cms/sec. natural

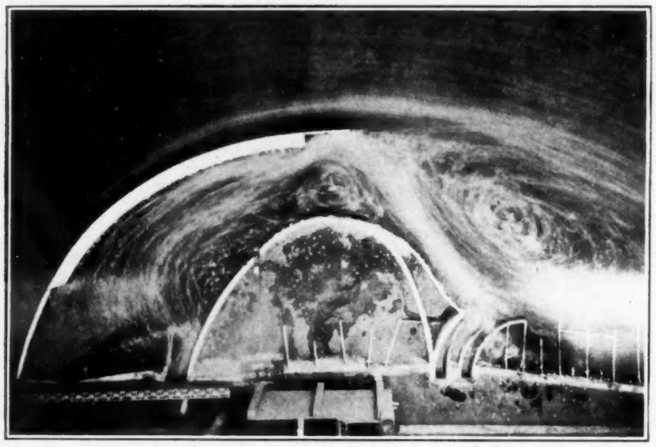


Fig. 9.—Project Lab. 3: Flood current.

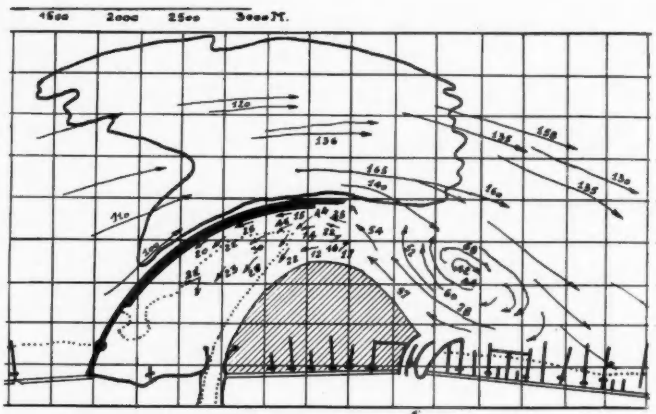


Fig. 9a.—Project Lab. 3: Flood currents. Velocities in cms/sec. natural.

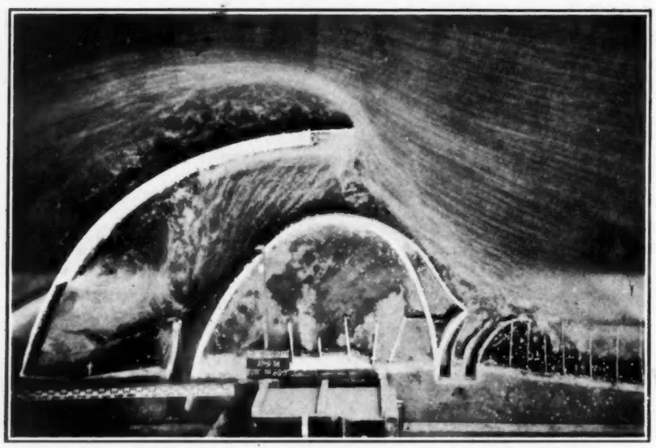


Fig. 10.—Lab. 3: Ebb currents.

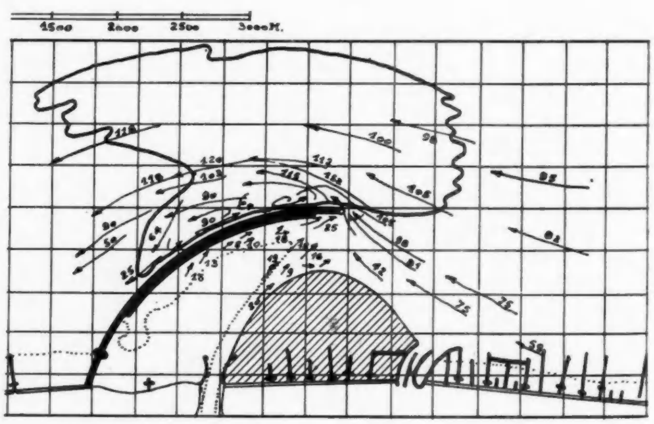


Fig. 10a.—Lab. 3: Ebb currents. Velocities in cms/sec. natural.

directly opposite the entrance canals to Heyst. There is little doubt that this eddy is caused by the friction drag on the flow of the tidal stream by the mass of still water in the roadstead. This was reproduced in the model effectively, as the photograph of Fig. **3** shows. In the opinion of the authors this large eastern eddy is the main cause of the silting in the harbour waters, providing, as it does, the natural vehicle to introduce into the sheltered waters about twice the quantity of water necessary for the rise of tide (Adh/dt). This extra water carries its solids in suspension, and by rolling, into the quieter roadstead, and passes out into the sea again after depositing a considerable part of its solids burden. It is instructive to compare the Figs. 3a and **4**a and the photographs Figs. **3** and **4** of the model, with the actual tidal currents and directions of Figs. **5** and **6**. It will be noted that in Fig. **6** there is no indication of an eddy current just west of the mole head, but that it is plainly visible on the model as shown in

Model Experiments on Belgian Ports—continued

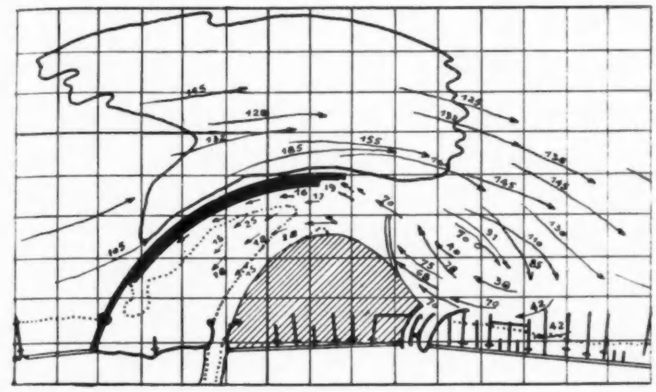


Fig. 11a.—Project Lab. 4: Flood currents. Velocities in cms/sec. natural.

Fig. 11.—Project Lab. 4: Flood currents.

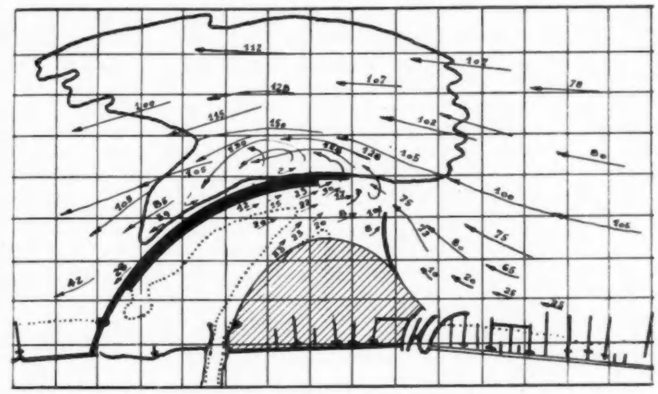


Fig. 12a.—Project Lab. 4: Ebb currents. Velocities in cms/sec. natural.

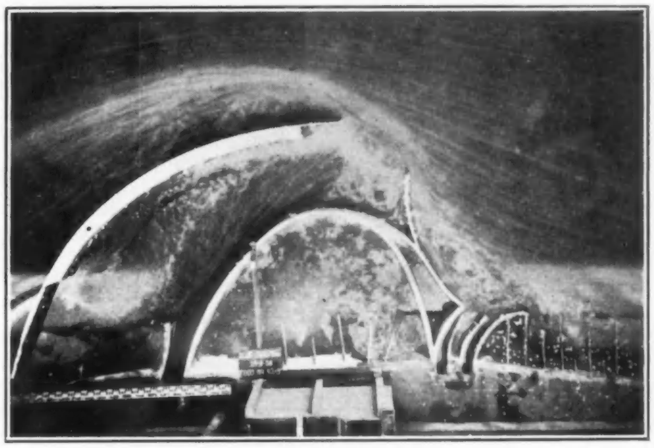


Fig. 12.—Project Lab. 4: Ebb current.

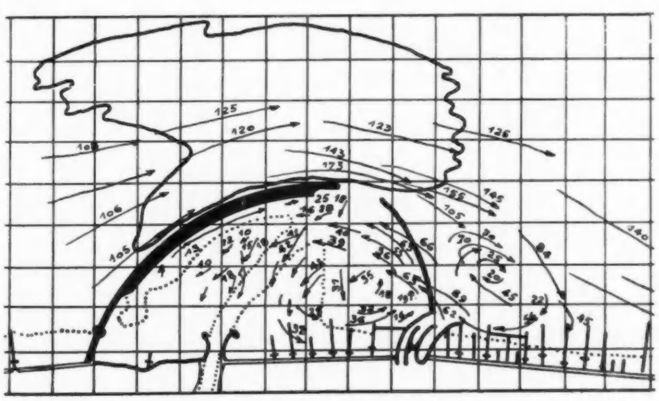


Fig. 13a.—Project M2: Flood currents. Velocities in cms/sec. natural.

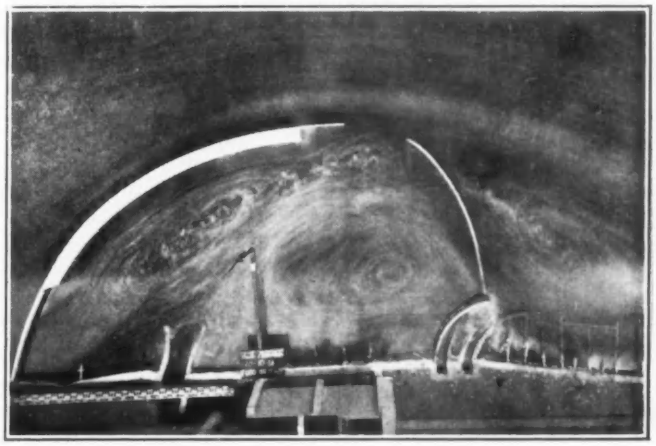


Fig. 13.—Project M2: Flood current.

Figs. 4 and 4a. Remarking this, the authors made a more detailed examination of the sea waters on the outside of the mole due N.W. from the head and found that it actually did exist in nature.

Project T.14.

This project incorporated a peninsula of a parabolic form stretching into the roadstead with its tip south of the mole head and based on the shore line from the east arm of Bruges Canal entrance to the west arm of Heyst entrance channel as shown in Figs. 7a and 8a.

The tests show that there is some improvement at the harbour entrance on a rising tide; the large eddy to the east is appreciably diminished, and thrown still further east, away from the entrance. The currents at the harbour mouth are more uniform but are concentrated in the half near the mole whereas in the other half

Model Experiments on Belgian Ports—continued

near the tip of the bulge there are indications of slight eddies and weak flow. The tests during ebb tide show little difference near the entrance to that of test T*o*. The main drawback of project T14 is the probable formation of a mudbank to the east of the bulge in the region of the large eddy with the consequent threat in the future of a mud invasion of the port. (See Figs. 7 and 8).

Projects Lab. 3 and Lab. 4.

Tests on the project of Lab. 3, which only differs in form from T.14 in that the base of the bulge at the shore line was extended to the head of the western arm of Heyst Channel, Figs. 9a and 10a and the photographs Figs. 9 and 10, of the model, show very little difference to T.14.

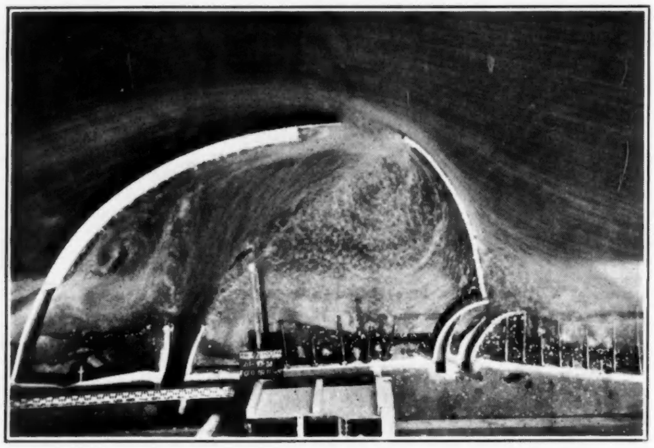


Fig. 14.—Project M2: Ebb current.

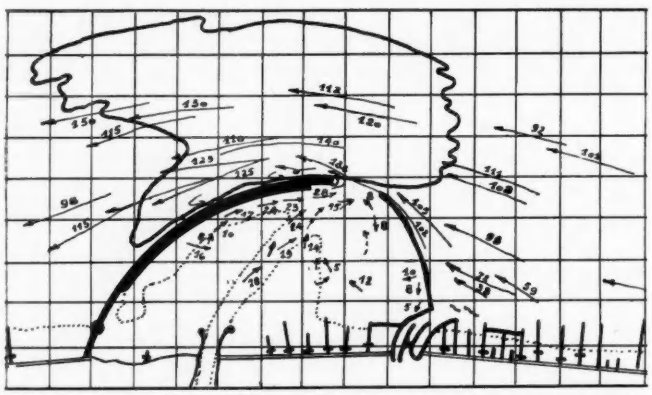


Fig. 14a.—Project M2: Ebb currents. Velocities in cms/sec. natural.

The form Lab. 4 differs from the preceding insomuch that a low jetty with the top only 43 cms. above the fixed low water level that is at (+1.50 m) is added to the eastern side projecting into the sea due north towards the mole head. On the flood the currents at the harbour mouth are satisfactory, see Figs. 11a and 12a and photos Figs. 11 and 12. The authors have this to say about Lab. 4, " . . . . there is need to examine how far this improvement can be maintained. It is highly probable that the advantage gained with regard to T.14 remains fairly small, because this last state is close to the project of maximum improvement, so long as the open viaduct remains closed. Now in the vicinity of a maximum, the variation of the functions representing natural phenomena are always feeble. Again, the construction of this jetty represents added cost and its presence would entail danger to shipping."

On the ebb tide it is seen that the water will leave the harbour over the whole entrance width. The acute angle between the low jetty and the bulge is an unfavourable feature.

Project M.2.

The form of this project is the provision of an eastern arm to the harbour with its root at the head of the western arm of the Heyst Channel. It curves from the root to its seaward extremity to form a narrower entrance to the harbour than the other proposals tested. It is the obvious answer, anticipating criticism, to the school of thought which supports the orthodox harbour shape of two curved arms. The authors were perhaps satisfied with the unfavourable results of the test as they dismiss the project in few words, maybe feeling that the photographs Figs. 13 and 14, and the diagrams, Figs. 13a and 14a, are sufficient evidence of its unsuitability. The eastern mole, such was their description, was however a submerged barrier at little more than low tide as it had its crest at (+1.50 m).

Summary of Current Tests.

The above experiments were all conducted with water free from solid content with the sole objective of first of all realising the actual current conditions in miniature, and secondly, to trace and record the changes of current flow by the introduction of the proposed constructions for improvement.

It was appreciated that the two sea zones of eddies, the large eastern eddy and the smaller western eddy, had considerable influence in the formation of mudbanks, as they promoted the decantation of the silt bearing waters. Although situated outside the roadstead they would tend to surcharge the waters entering the harbour at certain stages of the tide and weather, and thus give rise to the silting it was necessary to prevent.

The authors fully appreciated that these tests were only partial answers to the problem and did not exhaust all possibilities; parallel with the efficiency of any proposed method of regulation the capital cost of construction was considered in relation to the probable economic advantage to the port. This ruled out all schemes of a grandiose character.

Having by the above experiments verified the truth of the model and the current behaviour of the various projects a further series of tests with muddy water was commenced.

(To be continued)

Improvements at the Port of Beira.

Tenders for the construction of a new deep-water berth, to be known as No. 8 berth, and for the construction of a belt conveying system to serve it, capable of loading 400 tons of chrome per hour, have been invited by the Caminho de Ferro de Mocambique, which took over the operation of the Port of Beira at the beginning of this year. A certain amount of reclamation work which will be involved will be carried out departmentally. At present, there are five deep-water berths at the port, and the reason no invitations have been issued to tender for the construction of berths No. 6 and 7 is because these two berths form part of a long-term programme. It has also been arranged that the transfer by the Beira Railway Company, of the railway from Beira to Umtali, Southern Rhodesia, to the Caminho de Ferro de Mocambique will take place on the 1st October. Already a certain amount of rolling stock has been taken over by the Portuguese Authorities from the Rhodesian Railways, and the latter have agreed to help the Portuguese Administration generally by assisting them with the loan of wagons, etc., until they are able to completely equip themselves.

Port Unification on North East Coast.

Meetings are to be held this month to consider unification in control of the ports of Hartlepool and the Tees, and local representatives are to meet the Docks and Inland Waterways Executive to discuss the proposals. The undertakings which would come under one control, if the plans materialise, are Hartlepool Port and Harbour Commission, Tees Conservancy Commission, the British Transport Commission docks at Middlesbrough and the Hartlepools, Stockton Corporation Quay and some private wharfing undertakings. The Executive in a letter to the various authorities have stated that unification is essential to ensure the best use of the existing facilities.

Creosoted Timber Wharf at Portland, Oregon

By W. R. BOND.

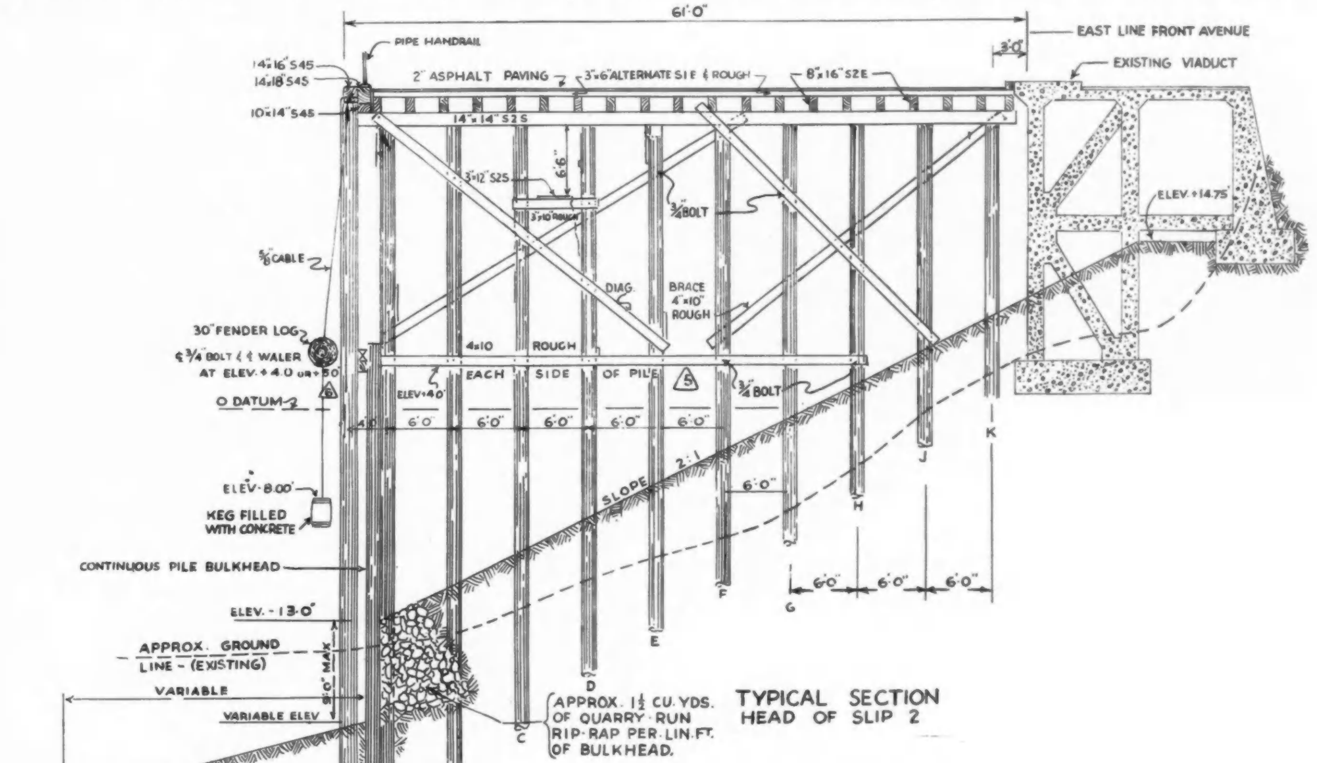
A dock estimated to cost $2,000,000 is under construction by the Commission of Public Docks at Portland, Oregon, on the Willamette River. This dock is located at the north end of Terminal No. 1, on a site acquired by the Commission from the Eastern-Western Lumber Company. The latest features in dock design are incorporated in the structure, which will provide berthing space for two ships on the 1,100-ft. harbour face and for an additional ship in a slant slip which indents the shore at an angle some 23° off normal for a distance of 640-ft. The pier is generally 100-ft. wide, and the slip side pier is also continued by a 61-ft. width of pile-supported platform at the inshore end of the slip. All piles and timber are of pressure creosoted Douglas fir.

The entire area, including the pier and the adjoining paved land, comprises $22\frac{1}{2}$ acres. The pier consists of a 39-ft. outboard apron or deck and a 61-ft. inboard width which, under the present schedule, will be an open deck. Later, however, this will be occupied by pier sheds, the width being sufficient to provide a 20-ft. loading platform in the rear of the sheds. The dock apron and loading platform will be built level with the street, but the area back of the loading platform will be depressed $3\frac{1}{2}$-ft. to expedite tail-board delivery to the platform. Ramps connect this depressed truck-way with the pier deck. All berthing areas are served by a double track railway with crossovers, which makes a complete loop around the pier.

A 3-ft. by 8-ft. rectangular concrete conduit along the land edge of the pier carries the various piping necessary for operation and acts also as a retaining wall for the head-of-bank. This conduit is founded on two rows of creosoted piles with cut-off some 10-ft. below deck level.

The river bed is on a 2 to 1 slope under the pier, and the toe of the slope is held by a continuous line of round timber piles driven in contact near the outboard end of the pier. A rock back-fill 9-ft. high containing approximately $1\frac{1}{2}$ cu. yds. of quarry run riprap per lineal foot is placed immediately behind the pile wall.

The pier proper is supported on pile bents on 10-ft. centres, running generally normal to the harbour line. Piles in a bent are spaced on from 3-ft. to 6-ft. centres, the closer spacing being common under the 39-ft. outboard apron which supports the railroad tracks. The bents are capped with 14-in. by 14-in. timbers and the apron deck is supported on 6-in. by 18-in. stringers on 2-ft. 6-in. centres, except under the railroad tracks, where three lines of 8 by 18s are used. The base of the 2-in. by 4-in. laminated decking on the outboard section is brought even with the top of the ties by 8-in. by 10-in. timbers laid across the stringers. On the 61-ft. width of platform provided for the future pier sheds, caps are elevated sufficiently to bring the 3-in. by 6-in. decking laid directly on the 8-in. by 16-in. stringers flush with the deck of the apron.



TYPICAL SECTION HEAD OF SLIP 2

NOTE: DIAGONAL, HORIZONTAL, AND SASH BRACES TO TERMINATE AT FINISH GROUND LINE WHERE FINISH GRADES RISE AT SOUTH END

The 2-in. by 4-in. apron decking is laid on edge, forming an irregular base for bonding with the 2-in. asphalt paving which covers the whole deck. Piles of the substructure are braced with horizontal and diagonal 4-in. by 10-in. bracing.

The fender piles protecting the base of the pier are themselves protected by a line of 30-in. logs, each 60-ft. long, suspended horizontally across the front of the deck and bearing against the fender piles.

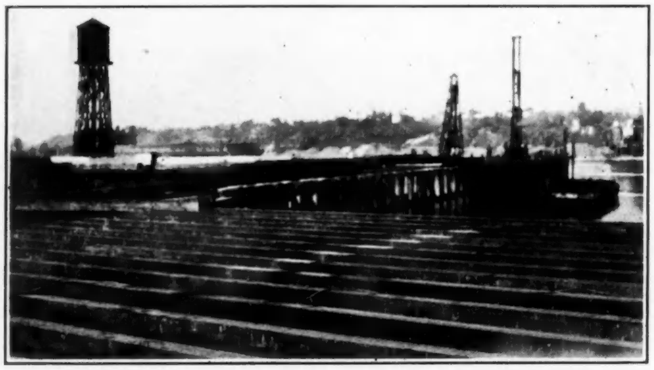
Concrete fire walls extend from low water to deck level at about 500-ft. intervals. In addition, timber draft curtains treated with fire-retardant salts are built approximately midway between each two concrete firebreaks. The dock is thoroughly protected by a modern sprinkler system and will be flood-lighted to improve night operation. The north end of the old Eastern-Western Lumber Company's dock is being used by the commission as a lumber export dock; and to avoid interruption of this operation the contractor is building the new dock in two sections. As soon as the first section, that on the slip side, is completed the lumber operation will be moved there, and the former lumber dock razed and replaced by new construction.

Creosoted Timber Wharf at Portland, Oregon

(continued)

All piles and lumber used in this new dock are pressure treated with a 50-50 creosote-petroleum mixture. The piles are treated with 10 lbs. per cubic foot; ties with 8 lbs.; lumber 5-in. and over with 8 lbs.; and that under 5-in. with 10 lbs.

More than 5,000 pressure creosoted fir piles, varying in length from 40-ft. to 110-ft., were used in this construction, and over 3,000,000 bd. ft. of pressure creosoted timber for caps, stringers, bracing, waling, etc. The job required 163,000 cu. yds. of excavation, 91,000 cu. yds. of fill, and 3,000 cu. yds. of concrete for the retaining wall at the inshore end.



View of wharf under construction, showing stringer system in place for extension at head of Slant Slip shown in foreground.

Contracts for the construction of the wharf were awarded to the General Construction Company of Portland. Flood conditions make it impossible to estimate the approximate date of completion, since considerable work must be done during the low water period, and a water rise in the river is normally expected in the late fall and again in the spring, but it is hoped the project will be completed early in 1950.

Col. Walter G. Kratt is general superintendent of construction and maintenance of the Portland Dock Commission, and Thane E. Brown is chief design engineer.

International Association of Navigational Congresses

(concluded from page 168)

From 1936 onwards matters were quite different. Congress starting a national policy of flood protection, the creation of the various works becoming a duty to the Federal Government. The enormous activity of the U.S.A. in this kind of work is explained by the existence of large urban areas in districts which are not entirely protected against floods.

Efficacy of a reservoir to lessen floods diminishes as the distance between its site and the area to be protected increases.

Considerations of an economic nature often lead to siting retaining-works on the upper basin of a river to be regulated, where good sites are found for the construction of barrages and where the land to be flooded is less expensive.

Therefore, when it is a matter of a big river such as the Mississipi, flood regulation by the sole means of reservoirs is quite impracticable.

In the case of a river basin of medium area, reservoirs can play an important part in fighting floods, although it is necessary to have recourse to auxiliary means if total protection is the object. If the basin to be regulated is still smaller, reservoirs can provide almost entire protection against floods. That is most frequently the case. As an example, Brigadier General Young cites in his paper plans for a system of reservoirs designed to protect Pittsburgh against floods, as well as the scheme for one of the reservoirs of this system, the Crooked Creek one, which is only used for production of electricity. The city of Pittsburgh is the centre of the American steel trade.

As regards the typical project of the Crooked Creek reservoir, the method of determining its capacity and the calculation of the spillway is worthy of note. For this purpose two hypothetical floods are considered, reckoned according to the maximum probable floodwater. The latter is established, with a considerable safety margin, in comparison with pluvio-metrical observation-records extending to a vast region of the U.S.A. and not only the river basin, and it is seen that the storage capacities necessary for lessening floods must be great.

The paper by M. Bratranek (Czechoslovakia) deals with the problem of improving navigable conditions on the Elbe (Labe) from Strekov on, as far as the German frontier, a comparatively short sector (37 km) having a free flow, whereas further upstream the river is canalized by means of lock-dams.

To obtain a perfect regularisation, raising the low-water discharge to 290 m^3/sec. by means of storage reservoirs, it would be necessary to construct a system having a total capacity of 8,400 million cubic metres, which would not be justifiable from an economic standpoint.

If the authorities were satisfied with a less extensive regulation, but still of interest as regards navigation, the total capacity of the reservoirs planned could be reduced to 690 million cubic metres.

However, in that case, in addition to the building of reservoirs, it would be necessary to regulate the low water channel below Strekov, with a view to lessening its width, which has raised serious objections owing to hampering which this reduction of width might cause to operating ports situated on the regularised part of the river. If these difficulties cannot be overcome, the only acceptable solution may possibly be to increase the number of navigation-locks.

The paper by Messrs. Volker and Schoenfeld (Netherlands) studies, from a theoretical stand, the characteristics of flood undulations.

By means of certain simplifications a differential equation (11) is deduced, valid for slight increases of depth as compared to the initial depth. A solution representing a symmetrical undulation in the shape of a bell is discussed. The equation (13) helps to determine the displacement of the summit of this undulation, which becomes gradually longer and less high in the course of time, without its volume being changed. Sinking of the wave is defined by the equation (14) or (13).

Sudden increases of the flow or level, at a given spot, cause transitory movements, the duration of which is approximately determined by the equation (21), which gives a means of studying to what extent an increase of storage may lessen a flood.

This theory is applied to the study of the wave which moved successively in the Möhne, the Ruhr and the Rhine when the barrage on the Möhne was burst in 1943 by the Allies' airmen. It was a reservoir holding about 100 million cubic metres, most of which was emptied.

The influence on floods by canalisation of a river and storage reservoirs is discussed succinctly.

The paper ends with six conclusions, of which the fourth states that "on a canalised river flood-waves remain more irregular and less high than on a non-canalised river"; the sixth says that "the capacity of a regulation-reservoir for lowering high levels on a large river ought to be considerable and above all greater than the capacity of a holding-reservoir built for maintaining a minimum flow."

The Portuguese paper by Professor Manzanares presents considerations of a general nature in regard to the interests of inland navigation and discusses in particular the possibilities of building navigable waterways in Portugal.

It stresses the necessity of a general plan for regularising each river basin, concerning all its works to make use of the water and to give protection against floods.

One is thus conduced to systems of multiple-purpose reservoirs, the planning and operating of which are very delicate matters.

Nevertheless, such systems are already functioning in the U.S.A., the most remarkable being that of the Tennessee Valley, a gigantic undertaking of worldwide fame.

Correspondence

To the Editor of *The Dock and Harbour Authority*.

Dear Sir,

Fire Fighting at Ports

It was with great interest I read Admiral Higbee's article on "Security of Port Installations and Ships in Harbours," which appeared in the September issue of your Journal. At this port of King's Lynn, the Docks and Inland Waterways Executive have a completely trained fire brigade, equipped with one major 500 and two 250-gallon pumps, 2,000 feet of hoses, foam branches and all ancillary equipment for fire service.

Just over three years ago, when I was appointed dockmaster to the King's Lynn Docks and Railway Company, I made a tour of inspection of the fire appliances. Having served twenty years in tankers makes one fire conscious, and I was far from being favourably impressed with the conditions I found.

I decided to try and form a fire brigade, but found it was an uphill task to get the "Powers that Were," to grant money for a project, which I am sure they deemed unnecessary. Finally with the persuasive talking ability of my friend, the Docks Engineer, the directors allotted a sum of money to be spent on the purchase of new equipment, uniforms for the men, and the wages of a full-time fireman.

Employees from a good cross-section of the Dock staff volunteered and were enrolled, and a full-time fireman of 17 years fire service was appointed to instruct them in fire prevention and fire fighting. Contact was made with the N.F.S., and under their wing the brigade became first class.

The brigade has fought successfully numerous fires of a varying degree from large grass fires to small fires in the electric cranes. These fires would have undoubtedly, had they been left, caused damage and may be a great loss of money. The dock fire brigade being on the spot and quickly dealing with them prevented this. During the great floods of March 1st, 1949, the brigade did magnificent relief work, and earned the personal thanks of the Fire Chief Officer, Norfolk Fire Service.

Yours faithfully,
E. J. WHITE,
Dockmaster.

Docks & Inland Waterways Executive,
King's Lynn.
8th September, 1949.

To the Editor of *The Dock and Harbour Authority*.

Dear Sir,

Canals and Inland Waterways

A suggestion was made by Mr. Aickman in the correspondence columns of your July issue, that the cost of carriage by water should be ascertained. In reply, I would state, firstly, that the cost of carriage by different sizes of craft on differing waterways is known; secondly, that there is hardly a single waterway that operates at the cheapest possible cost, and in consequence the known costs would be somewhat misleading; and thirdly, that the cost of carriage from door to door is what really matters, but this cost depends on geographical situation, the nature of the commodity, etc. For the moment, it is sufficient to say that water transport is convenient and cheap, and in some cases, unavoidable, between ship and depots, factories and so on, lying inland, and for the conveyance of goods from industry situated on a water route to a port, and for coal and minerals when the lay-out is convenient.

On these grounds some navigations can serve transport well, but there is room for either their improvement or further development; these navigations are—going clockwise round the country and omitting one or two very short but useful canals—the Weaver, the Yorkshire Ouse, the Aire and Calder, the Sheffield, the Trent, the Thames and the Severn; the well-laid out Shropshire Union Canal might well be enlarged to a 100-ton standard at least, so as to link Wolverhampton with the Mersey, via the River Weaver; enlargement of the southern end of the Grand Union Canal also might prove fruitful.

In articles written by me, which you kindly published last year, I mentioned many of the points which are essential to the efficient improvement and operation of our waterways. The history of the canals is one of lost opportunities, beginning with failure to improve during the period 1810-1840; it has been a story of retreat. To-day there is wanted at the top, broad vision, resolute purpose and original thinking. I recall the man who made the Severn Tunnel, who went against the advice of everyone, undertook to do with his own resources and skill what the Great Western Railway would not do; who carried on in opposition to his work people (and I am not surprised that they disliked the job) flooded out up to the crown of the tunnel and up the shafts, with steam pumps and no spares, with inefficient diving apparatus. He won through. I think his name was Walker.

Where is a man like that to handle the waterways? Where is the man to stem the retreat, to turn it into an advance? Where can be found the Montgomery of the Canals?

Yours faithfully,
C. T. GARDNER, M.Inst.T.

Nyeri, Kenya Colony.
15th September, 1949.

To the Editor of *The Dock and Harbour Authority*.

Dear Sir,

Navigational Buoys

Referring to the August number of *The Dock and Harbour Authority*, my attention has been drawn to the possibility of misapprehension arising from the article by Mr. Stanley C. Bailey on page 115, entitled "The Construction of Harbours." The painting and numbering of buoys throughout the United Kingdom now conforms, or will shortly conform, to the International Agreement of 1936 for a uniform system of maritime buoyage. The paragraph referring to buoying should be amended as follows:

> "The edges of the main channels through or round the harbour bar and the river navigable channels will require to be buoyed on the port or left side when entering from seawards by can-shaped red or red and white chequer painted buoys for main channels or red and yellow chequer painted buoys for subsidiary channels and on the starboard or right side when entering from seawards by conical black or black and white chequer painted buoys for main channels or black and yellow chequer painted buoys for subsidiary channels. The buoys will be numbered from seaward, the port hand buoys bearing even numbers and the starboard hand buoys odd numbers with, if necessary, an identifying letter for a particular channel."

Yours faithfully,
W. R. COLBECK,
Marine Surveyor.

Mersey Docks & Harbour Board,
Liverpool, 3.
31st August, 1949.

[Although the Uniform System of Maritime Buoyage has not been fully ratified, it has been adopted throughout the United Kingdom, details of the new system being given in Admiralty Notice to Mariners No. 1587 of 21st June, 1947. The whole of the buoyage in the River Mersey and the approaches was converted to the new International System in the Spring of this year, and we understand that the change to the new system by Trinity House is practically complete. We are not aware to what extent the new system has been adopted by foreign countries.—Editor.]

Obituary

We regret to announce the death on 3rd September last of Mr. Walter Edwin Tapper, A.M.Inst.T., General Assistant to the General Manager of the Port of Bristol Authority.

Mr. Tapper, who was 63 years of age, joined the Port Authority in 1914 and was seconded to the Bristol Chamber of Commerce for special duties connected with railway rates problems from 1924-1927. In 1930 he gained the Institute of Transport Gold Medal for his paper on "Causes of and precautions against congestion at ports," and he has since made other notable contributions to the Transport press. He served for many years on the Committee of the Western Section of the Institute of Transport and held office when the section was inaugurated in 1926.

At the funeral service at Arnos Vale Crematorium, the large number of business associates present included representatives of the Port of Bristol Authority, the Railway Executive, local shipping and stevedoring firms, the grain trade, and the Town Clerk of Bristol.

The Automatic Electric Tide Gauge

By J. C. BROWN

Dipl. Eng. (University of Liverpool), A.M.I.Mech.E., A.M.I.S.E., Engineer to the Isle of Man Harbour Board.

Since man first embarked upon nautical pursuits he has been in contact with the flow and ebb of the tides; and since he first became conscious of calibration, he has measured the rise and fall, at first, perhaps, crudely and informally, but later with the application of technical skill and some understanding of the laws which govern this spectacular phenomenon. Many countries therefore, which possess a seaboard, have produced observers and investigators who have contributed to the accumulated knowledge of the behaviour of the tides.

Up to the middle of the seventeenth century most of the knowledge was of an empirical nature, obtained by direct observation and experience; but from then onward numerous investigators have been busily engaged upon deducing, by observation and theoretical reasoning, the laws of causation. Many grotesque theories have been advanced, and it is only in recent times that theory has been found to be in accord with observed phenomena, although much of the former is imperfectly understood.

Mariners benefited by a knowledge of the tides for centuries before the subject was taken over by men of science, and systematic predictions, resulting from analysis of a prolonged series of tide gauge readings, were prepared and published by clergymen and others whose pursuits were, not infrequently, far removed from the sea. Although these predictions served a practical purpose in their time, and had some merit in the matter of accuracy, they are not comparable with the remarkable accuracy of present day computations. The simple tide gauge, therefore, upon which the ebb and flow of the tides have been observed for centuries, is the humble instrument from which the whole complex subject has evolved.

Any apparatus employed for measuring the height of the tide may be termed a "tide gauge." The graduated tide board fitted vertically to some harbour structure, and set to a definite datum, is invaluable for harbour service. It is a tide gauge in its simplest form, yet it is permanently free from error and serves as the "standard gauge" for setting and checking automatic gauges. Despite its fundamental value, however, it has limitations in that eye observation is difficult if there is any wave action; it is inconvenient to obtain accurate readings during bad weather and during hours of darkness, and it requires frequent cleaning to maintain it in legible condition.

To avoid wave action a natural development is to be found in the use of a tide well or enclosed shaft to which the sea has entry well below low water mark. The rise and fall of the water in the well can be accurately measured, relative to some fixed mark, by a metal tape measure; but invariably a tide well is used to accommodate a float. Initially the float was fitted to a tide pole from which readings were obtained by virtue of its rise and fall with the tide; but where a big range is encountered the apparatus becomes mechanically clumsy, and a more modern development is found in the use of a flexible wire attached to the float, passing over a wheel and attached to a suitable counterpoise. The rotation of the wheel can be employed to register the height of the tide, and by the introduction of gearing and a clockwork operated drum, a continuous record of the tide can be obtained. Tide gauges based on this principle are numerous and are being used with effect throughout the world.

In later years, much inventive exercise has been expended on the design of tide gauges based on the change of pressure, at a fixed point below the sea, as the tide rises and falls; but despite the many ingenious productions, the float operated gauge maintains its popularity.

An efficient self-recording tide gauge has become an essential feature of harbour equipment from an administration and engineering aspect, particularly in a tidal harbour. The speed with which vessels have to be "turned around," coupled with the revolutionary change in design and complexity of modern ships, involves the closes attention to their movements relative to the ebb and flow of the tide. The "neaping" of a vessel, in a tidal harbour, must be avoided; yet full advantage must be made of available berthage. Under such circumstances, vessels may be moved with very little water beneath their keels; an efficient self-recording tide gauge is, therefore, an invaluable aid to the harbour master in the performance of his exacting duties.

In the opinion of the author, the automatic electric tide gauge, of the type installed at Douglas Harbour, maintains such a high degree of accuracy and efficiency as to merit recommendation. This apparatus, a description of which follows hereafter, possesses many advantages over the ordinary mechanical float operated indicators; it is compact and occupies very little space, a tide shaft of only a few inches diameter is required, repeat indicators can be operated from the master instrument, and the "submergence error," inherent with the ordinary mechanical float indicators, can be practically eliminated.

The gauge at Douglas Harbour (Fig. 1) was constructed to the general specification of the Isle of Man Harbour Commissioners by a reputable firm who specialise in the manufacture of electrical bore-hole depth indicators. The whole of the equipment, with the exception of the plumb-bob element, is contained in a completely enclosed cubicle measuring 6-ft. 8-in. high by 2-ft. 10-in. wide and 1-ft. 6-in. deep. It is built of steel with crystalline finish and provided with doors on either side for easy access to the various units. A 2-ft. 9-in. diameter dial, mounted on the face of the cubicle, is graduated to cover the range of Spring Tides of 21-ft., with a plus and minus graduation of 4-ft. to cover exceptional floods and ebbs. A pointer indicates the height of the tide and two "friction arms" are fitted to record the highest and lowest points to which the pointer has travelled during the cycle of a tide. During the process of the flood tide a green light is exhibited, and during the ebb a red light is exhibited on the dial. Immediately below the dial there is a compartment containing the recorder unit, with 65-ft. continuous roll chart, 6-in. wide, and syphon reservoir pen; in operation, a chart provides a complete tracing of the tidal movement for a period of a month.

Two underground three-core cables lead from the master instrument (a) to the harbour master's office in the inner harbour, a distance of 440 yards; and (b) to the harbour radar control room in the outer harbour, a distance of 870 yards, to operate distant repeater indicators. The repeaters (Fig. 2) are glass covered flush wall mounted dials 2-ft. diameter.

The gauge is energised from the mains supply of A.C. 230 volts single phase, which is passed to a double wound transformer to reduce voltage supply to 50 volts and 20 volts. The relay, controlling the operation of the motor, has a second winding connected across the supply mains, the effect of which is to make the system entirely independent of any variation in the mains voltage.

The most vital unit—and, indeed, that upon which the sensitivity of the instrument depends—is the plumb-bob element, which forms contact with the sea. This unit operates on the inductance principle and contains no electrical contacts. It is, in effect, a small enclosed solenoid through which passes an iron core supported by a small float. When the plumb-bob is lowered to the water, it stops automatically on reaching it and maintains itself thereafter at water level.

The mechanism is shown pictorially in Fig. 3, together with the associated electrical circuit. The two-core flexible cable, to which the plumb-bob is attached, is wound on a drum which is driven by a motor which automatically raises the plumb-bob as the water rises, or on the contrary, pays out more cable as the level falls. The pointer on the dial, and the recorder, are connected by gearing to the winding drum and show mechanically the length of cable paid from the drum, and therefore show the level of the water.

The relay has two coils connected in parallel across the secondary of the input transformer. One coil is in series with a fixed impedance and the other in series with the plumb-bob element. Any change in level of the water will therefore vary the impedance of the plumb-bob solenoid, thus altering the current in one coil of the relay. Two contacts on the armature of this relay therefore cause the motor, which drives the drum, to wind up or pay out cable, so maintaining the plumb-bob solenoid in a central position.

The Automatic Electric Tide Gauge—continued

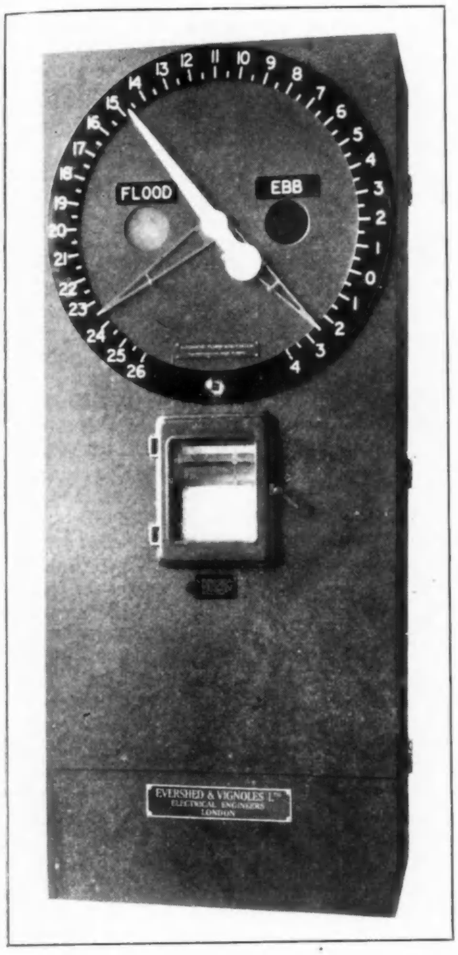


Fig. 1. Tide Gauge Cubicle *(photograph by courtesy of Messrs. Evershed & Vignoles Ltd.)*

Fig. 2. Wall Mounted Repeator or Distant Indicator.

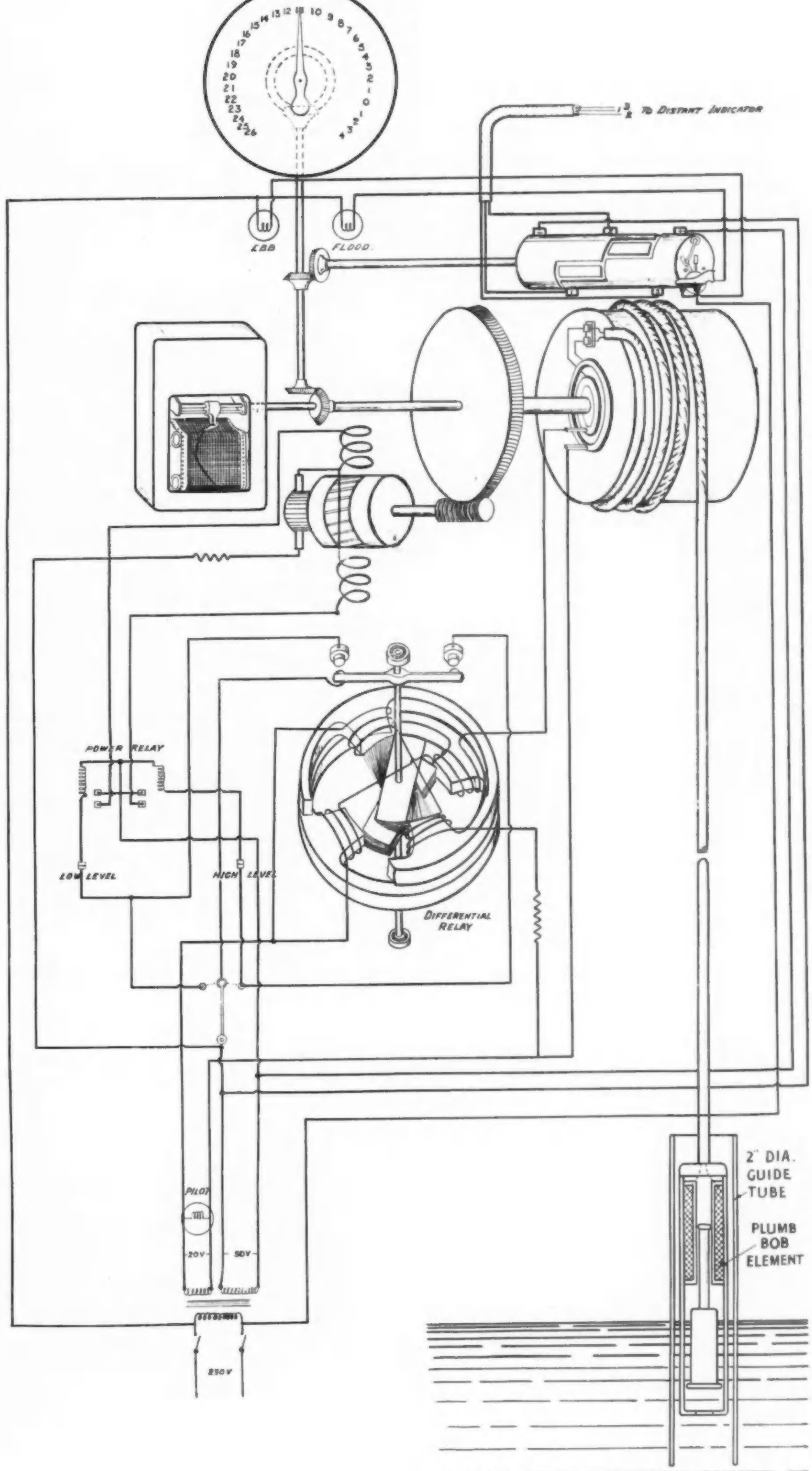


Fig. 3. Automatic Electric Tide Gauge at Douglas Harbour.

The Automatic Electric Tide Gauge—continued

The sensitivity of the instrument is such, that a fractional move ment of the iron core from the position of equilibrium sets the machine in rotation, and consequently the pointer "follows" the tidal movement without any appreciable lag.

A selection from one of the charts (Fig. 4) illustrates the perfect symmetery of the "tide curve". The formation about high and low water is noteworthy, in so far as there is no indication of "submergence error," which is so often associated witn mechanical float operated gauges.

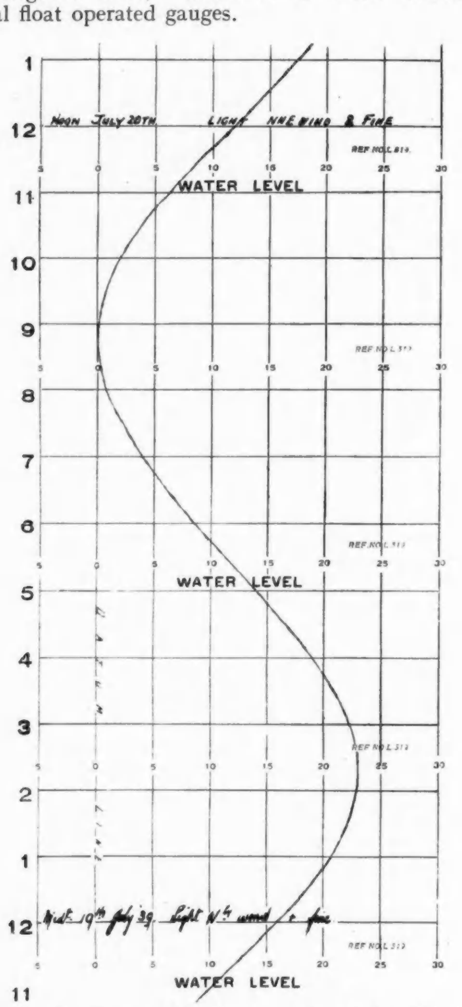


Fig. 4. Specimen of Tide Curve as Recorded on Chart.

The distant indicators are operated on "Powerotor" transmission system. The transmitter, which is driven by the plumb-bob motor, consists of a special stepped commutator having five brushes, two of which take the 50 volt A.C. supply; the other three are connected to the distant receivers, which are placed in parallel across the transmitter. Each receiver contains a sturdy little motor having a 6-pole stator and a laminated rotor, there being no brushes or contacts in the motor. The arrangement is such that a rotating "step by step" flux is created in the receiving motor, in step with the rotation of the transmitter drum. For example, one rotation of the transmitter drum moves the rotor of the receiving motor 12 progressive steps. The pointer is attached to the rotor and the tide reading is obtained from the circular dial.

The electric tide gauge at Douglas Harbour was amongst the first, if not the first, of its type to be installed at a coastal harbour. Its initial cost, plus installations costs, did not exceed £300; and annual maintenance, including power consumption of approximately 45 watts, has averaged only .46d. per hour.

The gauge has been in continual operation for thirteen years, excepting for a period of 30 hours, which represents the total of all stoppages for maintenance and adjustments during the whole of that time. Nothing in the nature of a major breakdown has occurred, nor have any of the principal units been renewed. It may have been expected that the cable, by virtue of its continual movement, would have required renewing; but it is interesting to note that the original cable, with the attached solenoid, is still in service.

The trouble free operation of the gauge, coupled with its persisting accuracy and remarkable efficiency, is an eloquent tribute to British inventive ability, skilled workmanship and high quality of materials.

Report on British Transport

Review of First Year's Working

The first annual report of the British Transport Commission, covering all nationalised transport services for the year 1948, was issued early last month, and shows a net deficit of £4.7 million, after charging interest and capital redemption. The actual revenue deficit before tnese charges is £1.7 million, and the Commission do not regard the position as satisfactory. While it is claimed that important economies may eventually accrue from the concentration of each form of transport on the services for which it is most suited, in view of the recent trends of traffic receipts and of expenditure, notably in wages, coal and steel, no hope is held out of early improvement. In fact, the deficit for 1949 is expected to be higher than in 1948.

The Docks and Inland Waterways Executive

Reviewing the activities of the Dock and Inland Waterways Executive, the report states that the dock undertakings formerly operated by canal companies, etc., viz., Sharpness, Gloucester, Weston Point, Goole and Regent's Park Canal Dock, came under control of the Executive on January 1, 1948, as part of the inland waterways systems to which they were attached. In the case of the railway-owned docks, representing about a third of the dock accommodation of the country, discussions were initiated to decide which docks to recommend for transfer to the Docks and Inland Waterways Executive and which should remain with the Railway Executive as coming within the definition of a "packet port." It was decided that the transfers of the docks should be effected by stages, starting with the South Wales Docks and the comparatively small undertaking at King's Lynn. Recommendations for the transfer of the docks at Hull, Grimsby and Immingham were subsequently approved to operate from January 1, 1949, and other transfers are expected to follow.

Mechanisation of Ports

At some ports much expenditure is needed to repair war damage and to modernise equipment. First importance is attached to measures to reduce the time spent by ships in ports and special attention is being given to implement the recommendations in the Final Report of the Working Party on the Turnround of Shipping. Mechanisation is continuously under consideration, and a number of long-term improvements are being studied.

With regard to inland waterways, the report points out that the Executive have from the first pursued a policy of decentralising administration to the greatest degree compatible with unified control of policy and finance. During the war, arrears of maintenance accumulated, and the prerequisite of a waterways system capable of carrying greater traffic, or even of holding the traffic it already had, was a general improvement in the standard of dredging, especially in sections where boats could not be loaded to full capacity. The unification of the canals enabled dredging plant to be transferred from one division to another as required. Next in importance was the restoration of canal banks and towpaths and in some places, overcoming the shortage of cranes and other equipment for handling traffic. Equipment has remained scarce but, by pooling resources, some progress has been made in speeding up the discharge of craft.

Packaging Standards

First Packaging Code for Industry issued by the British Standards Institution.

In 1943, the war-time Ministry of Production sent an urgent request to the British Standards Institution to prepare a comprehensive Code of Packaging, as the losses of material and equipment were running high through faulty packaging and hazardous war-time shipment to the Middle and Far East theatres of war.

The object of the first Code was therefore mainly to guide Service and Government Departments, and their packaging contractors, in selecting and determining the right type of packaging for any product, the materials to use, and the method of construction.

Since then, the war effort has been replaced by the drive for exports, but one consideration still remains supreme—the avoidance of preventable losses of any kind. As in war, Britain's production machine has enough to do without being called upon to replace goods lost through deterioration or damage in transit. The loss of a battle may no longer be traced back to the packer—but the loss of an export market most emphatically can be.

The Packaging Code (B.S. 1133) has therefore been completely revised and extended under the supervision of the B.S.I. Packaging Standards Committee, representative of 24 trade and scientific bodies, eight government departments, large trading concerns, and individual packers. This Committee has been assisted by Technical Committees of experts for each individual section of the Code.

Contents of the Code

Considerable structural and textual changes have been made to the Code to suit present-day needs, particular emphasis having been given to the packaging of the products of industry for home and overseas distribution. Several sections of the first edition of the Code have been sub-divided and merged with others (e.g., "Methods of test"—the tests now being included in the individual sections to which they relate. Other sections have been merged (e.g., "Choice of containers and method of packaging"); expanded (e.g., "Handling of packaging materials and filled containers"); and new sections have been added (e.g., "Protection against pest and mycological attack, packaging felt, storage of containers and packaging materials").

The work is too large to issue, or even compile, as one complete entity. It is therefore being published as 17 sections, as and when ready. The first three sections are grouped together as the "Introduction to Packaging," in which the principles governing design, construction and materials are outlined. This is the all-important basic approach to the Code, and is now being issued, price 4s. net, post free. The individual sections included in it are:—

(1) Choice of containers and method packaging.
(2) Storage of containers and packaging materials.
(3) Addressing, marking and identification.

Five other sections are also available in completed or provisional form, viz.:—

(8) Wooden containers (6s. net, post free).
(9) Textile bags, sacks and wrappings (3s. net. post free).
(11) Packaging felt (2s. net, post free).
(14) Adhesive closing and sealing tapes (2s. 6d. net, post free).
(15) Tensional steel strapping (2s. net, post free).

Four sections are in an advanced state of preparation. They will be issued in the near future, viz.:—

(4) Mechanical handling of packaging materials and filled containers.
(6) Protection against corrosion.
(7) Paper wrappers and containers, including films, foils and laminates; and
(17) Wicker and veneer baskets.

Work is proceeding as rapidly as possible on the remainder, viz.:—

(5) Protection against pest and mycological attack.
(10) Metal containers.
(12) Cushioning materials other than felt.
(13) Cordage.
(16) Adhesives for packaging.

Each section, as a rule, gives definitions of the materials or methods concerned, notes on their use, standards of performance required, methods of testing, and illustrations (photographic and diagrammatic) of uses and testing appliances.

A glossary of packaging terms is also in preparation.

Copies of the introductory and other sections, as published, may be obtained from the British Standards Institution, Sales Department, 24-28, Victoria Street, London, S.W.1.

The Four Main Obstacles to Safe Delivery

Summarising the hazards which militate against the delivery of goods in a serviceable condition to the user, the Code singles out the four following factors as being the chief dangers:—

(a) Moisture in all its forms.
(b) Inadequate and unsuitable packaging.
(c) Bad and careless handling.
(d) Unsuitable storage before, during and after transport.

Insurance companies name theft and pilferage as being the greatest single source of loss. While better packaging can undoubtedly help, no package is proof against the determined depredations of organised looters or of petty pilferers in suitable circumstances. The Code's recommendation is the use of strong containers properly sealed.

Choosing the Container and Packaging Method

While the first consideration in planning the package is the degree of protection required by the product itself, many others enter into the account, including the cost of packaging, and the skill of the operatives who do the packing.

The following are some of the headings influencing the choice of container and packaging method, each being related to the other in the build up, the final package being the minimum required for safe delivery in the particular circumstances.

1.—**The destination.** The same package will not do for home and overseas. Even the shortest oversea trip involves transport, loading, stowage, unloading not encountered at home. The risks involved at each handling are the same whether the goods be sent across the Channel or around the world.

2.—**Methods of transportation and handling.** No guarantee can be expected of good facilities oversea. On the contrary, actual reports received by marine underwriters prove that recovery from the ravages of war is slow, and port improvement schemes languish behind schedule. Outside Europe, North America and Australasia, cargoes are still lightered ashore. Weak packages are crushed in the process in nets or by being stowed in lighters under heavier goods. Even in Europe this is true. It has been reported from Portugal that goods are sometimes left in lighters for several days. At a West African port—and many others—goods are discharged in the open roadstead into surf boats. Packages too large for surf boat handling fall overboard on being landed.

It is on record that in some ports there is deliberate mishandling by manual labour—for ease of subsequent pilferage!

When goods have to be taken inland they are usually given rough treatment on river craft, roads and railways, including exposure to the elements.

3.—**Climatic conditions.** In tropical countries rainfall is often measured in feet, not inches. Extremes of climate are experienced between day and night, with heavy condensation to cause deterioration of packaging materials and of products. The conditions are aggravated by exposure through lack of "undercover" storage. Certain ports provide nothing more than tarpaulins, and these in tropical climates.

4.—**Time lapse between packing and final delivery.** In normal conditions this would be calculable within close limits and the necessary protection provided. But a new post-war element has entered into the picture—port congestion through failure of the importer to take delivery owing to his inability to obtain an import licence or foreign exchange, or slowness in clearance through Customs, or a lightning ban on all imports. These, and lack of transport to the interior, create tremendous accumulations of goods, with more unloaded each day to increase the problem. Open storage on quays is now a common event. Congestion continues for months. The damage potential rises; and so does the opportunity for pilferage.

The Migrations of a Sicilian River's Mouth over Eight Centuries

By DR. AGATINO d'ARRIGO

Consultant to the Italian Hydrograhical Service, Maritime Division. Member of the Commission of Researches into the Regime of Italian Coasts of Ministry of Public Works.

Translator's Note

The River Simeto is on the east coast of Sicily, about 8 miles south of the Port of Catania. Dr. d'Arrigo, in the following paper, has dealt with two most interesting points that will undoubtedly occupy the attention of geologists, physiographers and oceanographers. In the first place, he puts forward the suggestion that the fluctuations, or migrations, of the river mouth of the Simeto is rhythmical with a well defined period of change, as though the direction and the position of flow into the sea are influenced by the harmonics of the ocean. The second point is the order of the deposit of the alluvium in two lines of banks on the coastal platform of this almost tideless sea, taking into consideration that the original marine bay of the Simeto is now mature and absent of all external obstructions.

A similar set of conditions and growth has brought about the maturity of the Gulf of Latmos in the Aegean Sea, into which the River Mendere flows at Miletus. It should be borne in mind that the examples given by Dr. d'Arrigo are not similar to the movements of the outlets of the River Adur at Shoreham, or the River Alde at Orford, which were influenced in their courses by the growth of shingle spits across their original outlets.

The tendency for rivers to flow to the right in the northern hemisphere and to the left in the southern hemisphere has of late received much serious support.

The River Simeto

The problems arising from the instability of the delta of the River Simeto have almost a classical ancestry, and have even occupied the earnest attention of one no less important in classical works than Pliny the Elder. Under the direction of the Italian State, in February, 1948, Professor Marco Visentini, President of the Italian Higher Council of Public Works, consulted with the Committee of Reconstruction of the Province of Catania, Sicily, with the object of formulating ways and means of tackling the problem scientifically in the light of modern knowledge and practical method. The outcome of this meeting was the accumulation of a quantity of historical data and a recent survey of the sea-bed fronting the delta. The civil engineers of Catania carried out the whole of the hydrographical work and neglected no part of the submerged platform, collecting all relevant data. In a similar way, the whole river system of the Simeto watershed was surveyed and the flow systems checked (see Fig. 1). The result of this intensive investigation brought to light interesting and important factors affecting the regime of all rivers, and particularly that subjected to severe and sharp floods. One outstanding feature of the conclusions deduced from authentic historical records is, as we shall see, a peculiar rhythm of change.

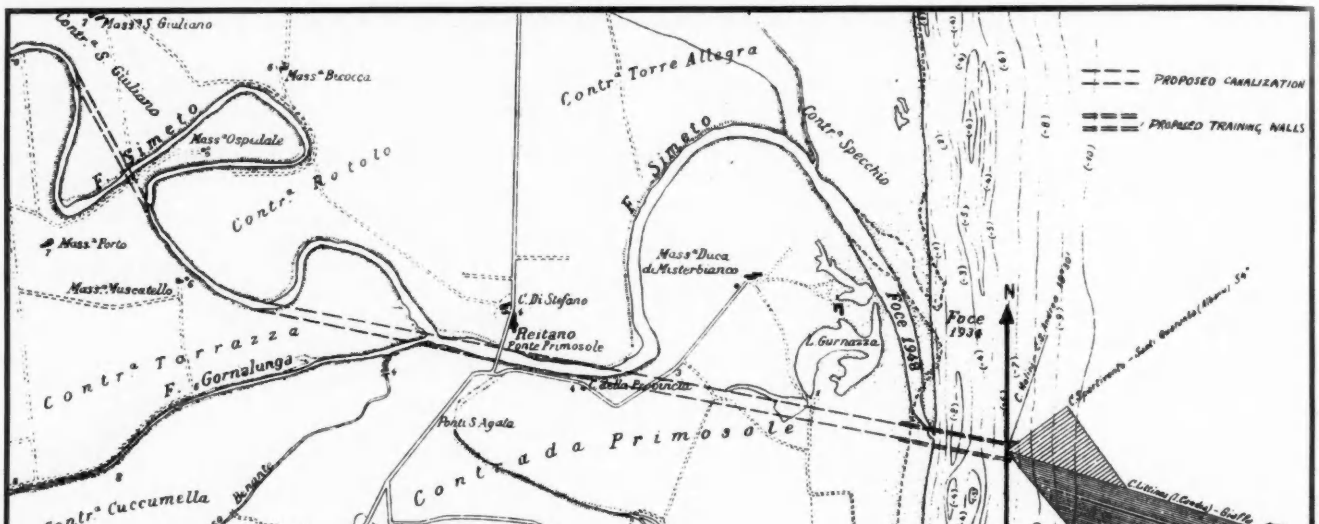


Fig. 1. The lower channel of the River Simeto; the "fetch" traverse distances diagram, and the proposed regularisation.

It is worthy of note that over one hundred years ago a celebrated Italian, Carlo Gemmellaro (1787-1866), who was, incidentally, the forerunner of the modern American School of Physiography, which reached its peak in the works of W. M. Davis (1850-1934), occupied himself closely with the physiographical regime of this famous Catanian foreshore. This coastline of the Plain of Catania stretches in an almost unbroken line for ten miles and is built up from the detritus and alluvium of the River Simeto, which is only 45 miles long. Gemmellaro traced the morphological changes in the Simeto estuary from 1552 to the time of the official report on the condition of the litoral ordered by Charles V in 1836. While Gemmellaro's main studies and researches were concerned with

Migrations of a Sicilian River's Mouth – continued

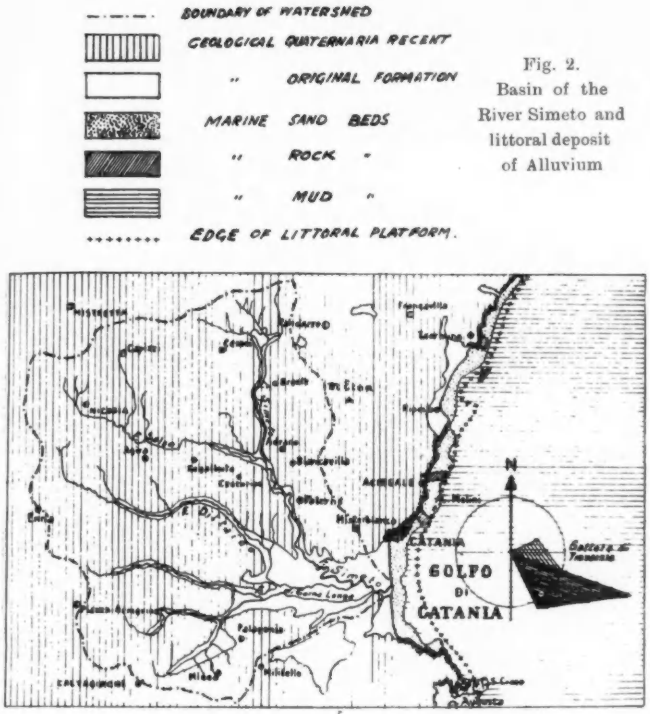


Fig. 2. Basin of the River Simeto and littoral deposit of Alluvium

vulcanology, he published in 1839 a monumental work in Volume XIII of the Proceedings of the Italian Academy of Natural Sciences on the physiographical origin and evolution of the plain of Catania, showing how the ancient estuary or delta of the River Simeto had been filled up with alluvium from the breakdown of soils and rocks of the watershed of the Simeto.

F. P. Gulliver, worthy disciple of Davis, taking the fundamental physiographical postulates of Gemmellaro, came to the conclusion that the present system of the Simeto outlet into the sea is one of Nature's best examples of a mature bay delta, formed by the filling in of the old marine bay or estuary, now occupied by the fertile plain of Catania, and due almost solely to the transportation of the alluvium by the Simeto and its tributaries.

Alluvium and Delta Growth

In 1936 the Simeto was gauged at Giarretta, which is 20 miles from the mouth above the confluence of the Gornalunga, where the watershed has an area of 700 square miles. It was observed that the flow at flood (10/12/1936) was 81,000 cusecs. From the calculations made from the records, it was estimated that the solids in suspension transported across this section were no less than 9,600,000 tons during the year; measured dry at 100° C this is equal to 13,800 tons per square mile of basin. In the same year the "Gela" at Dissueri transported 147,000 tons, equal to 1,600 tons per square mile of basin. These figures refer only to the material in suspension and do not include the solids rolled along the bed.

It was further estimated that the Simeto below the confluence with the tributary Gornalunga carried to the sea in the year 1936 a quantity of solids in suspension of no less than 22,800,000 tons, equal to 32,000,000 cubic yards of dry alluvium, and corresponding to 37,000,000 cu. yds. of alluvium in water, or about 13,000,000 cubic yards deposit on the sea bed. It is worth recalling that the River Po had been gauged at Pontelagoscuro during the years 1917 to 1933 and it was estimated that it carried in suspension to the sea annually 14,000,000 tons of alluvium, that is to say, only a little more than half the burden of the Simeto from a watershed sixteen times larger than the latter. In spite of this, the morphological growth of the submerged banks of the delta of the Simeto which is exposed to seas of the maximum "fetch" of the Mediterranean is considerably less than that of the River Po, exposed to seas of small "fetch," limited by the narrowness of the Adriatic. The solids discharged into the sea by the Simeto are dispersed to the north and south by wave action rather than by littoral current. In fact, whilst the northern shores of the Simeto outlet showed in May, 1948, three times the accretion of the southern shores, the contour lines of 5 metres depth were reduced to 1.4 metres, whereas the 10 metres depth contour were reduced only slightly.

The Littoral Platform

The width of the littoral platform near the mouth of the Simeto is about 3½ miles, whilst to the north near Catania it is about 4 miles wide. To the north the marginal ledge of submerged sand extends from the Simeto to Gaito Point, a distance of about 7 miles, where the lava of 1381 projects over the sea bed, bare of sedimentary material even to the depth of 29 metres. To the south the sand ledge stretches for about 10 miles to Brucoli, where it encounters the protrusion of the soft limestones of Val di Noto in a depth of 18 metres. The impulse of the waves models the morphological features of the coastline of the Simeto delta in the region above shallow depths to dry land, whereas to the seaward and in deep water, the littoral current is the prevailing modelling force.

In the period of 164 years between 1784 to May, 1948, the surveys carried out by Zahia and the civil engineers of Catania respectively show that two square miles of ground have been gained, equal to 1/85th of the area of the plain of Catania, which now extends over the old marine bay. The close hydrographic survey of the coastline of the Simeto delta carried out in 1948 shows the

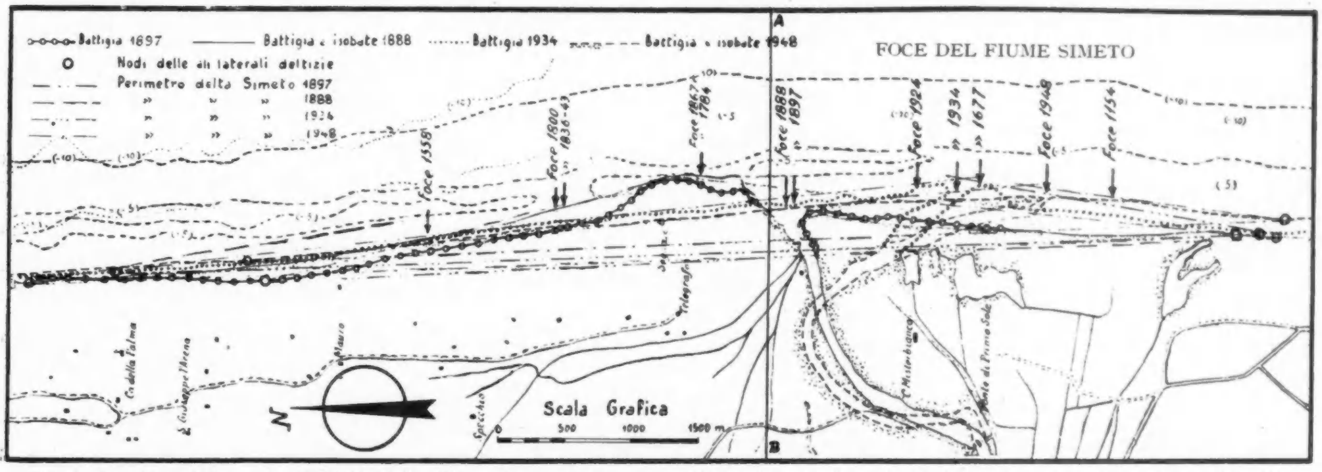


Fig. 3. Positions of the outlet (FOCE) of the River Simeto showing respective high water lines (battigia) and shore contours (isobate). A.B. is the nodal axis of the excursions.

Migrations of a Sicilian River's Mouth—continued

existence, parallel to the high water line, of two lines of submerged banks. The first line of banks lies at about **100** metres from high water mark in depths varying from 3 to 6 feet; the second line, which is more of a ledge or continuous step, lies at about **300** metres from high-water mark in depths of 11 to 14 feet. Between these two lines of bank there is a valley, or dike, about **20** feet deep. The transverse profile of these banks along the line of maximum slope to the marine depths shows a constantly greater steepness towards the land, thus revealing the morphogenetic action of the sea waves. Similar characteristics have been observed from the hydrographic survey of the Venice foreshores. Beyond the belts of banks, or ridges, the marine depths present a uniform and flat slope, inferior to one degree.

Submerged Bank Formation

Through this accidented bed of banks and valleys, the River Simeto tends to excavate an irregular and unstable channel of discharge, at all times influenced by the wave action which tends to bar the forward flow near the mouth. In particular, during the winter months (October to March), when the coincidence of river floods and heavy seas from the open fetch to the E.S.E. occur, the channel is subjected to maximum divagation and instability. To quote Carlo Gemmellaro, "The great mass of heavily laden water of the river Simeto discharge during the first autumn floods, encountering the seas at the mouth, deposit the suspended solids which form a bar, impeding immediately the free passage of the waters through the old channel. The result is that the plain of Catania in the low lying stretches of the river's course is inundated, causing great instability of the river banks near the outlet." There follows from these occurrences a great retardation in the regular flow, with the consequence that the river mouth becomes choked when the greatest need is to have an unrestricted channel to carry off the flood waters.

It will be appreciated that in view of these natural obstructions of the discharge of the River Simeto into the sea, it is imperative that the regularisation of the outlet channel should not be neglected. There is yet another cause of instability of the shores near the outlet, due to the hydraulic uplift occasioned by the many submerged springs of sweet water. Another consequence of these submerged springs is the accentuated flocculation of the marine alluvium as well as that borne by the river.

Outlet Migrations

From the extensive cartographical observations on the researches carried out of the divagations of the Simeto outlet, Dr. Olinto Marinelli (Fig. 4) has traced the positions at the various epochs from which we see that the mouth of the Simeto has travelled south to its position of **1948**, a distance of $2\frac{1}{2}$ miles since the year **1800** and no less than **500** yards since the year **1934** (Figs 2 and 3). The tendency to further movement of the outlet channel finds its mechanical genesis in the deepening of the waters near the right bank, as shown by the survey of May, **1948**, and the resulting disintegration of the earth forming the banks. This feature recalls the suggestion of Baër on the tendency of the gradual migration to the right hand of river channels in sedimentary soils in the northern hemisphere. Baër is not alone in this opinion, for the great astronomer, G. V. Schiaparelli, also suggested that in considering "the formation of the delta mouths of the great rivers, one must also pay regard to the sensibly uniform rotation of the earth in turning once on its axis in **23** hours **53** minutes mean time (24 hours sidereal time). In virtue of this, there arises the tendency of fluids to move out from the axis of rotation, constituting what we term a centrifugal force, which is not a true force like the others of natural origin, but simply a result of the inertia of matter."

The migration towards the south of the mouth of the Simeto should concord also with the cycle sense of the marine currents near our coast, according to the observations of Thor of the Oceanographic Survey (**1908-1910**) of the Mediterranean currents. Nevertheless, we also know that in the past (Fig. 3) there have been occasions when the mouth of the Simeto migrated towards the north, in a direction completely contrary to the phase to-day.

It is known from authentic records that the mouth of the Simeto in **1154** (Edrisi) reached its most southerly point, whereas in **1558** (Fazello) it was at its most northerly position, representing a range of over **3** miles. In **1677** (Massa) the mouth migrated south almost $2\frac{1}{2}$ miles. Another factor of the changing rate may be due to the fact that in, or about, the year **1621** the River Gornalunga became a tributary of the Simeto, whereas formerly it had followed its own channel to the sea, south of the Simeto. Carlo Gemmellaro had

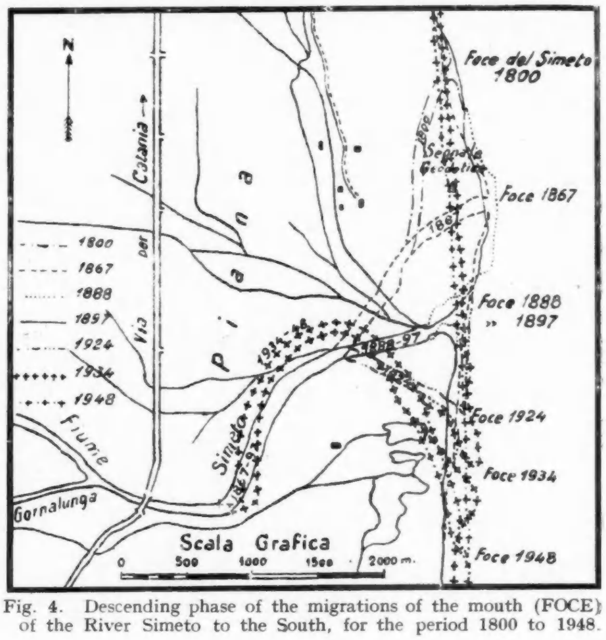


Fig. 4. Descending phase of the migrations of the mouth (FOCE) of the River Simeto to the South, for the period 1800 to 1948.

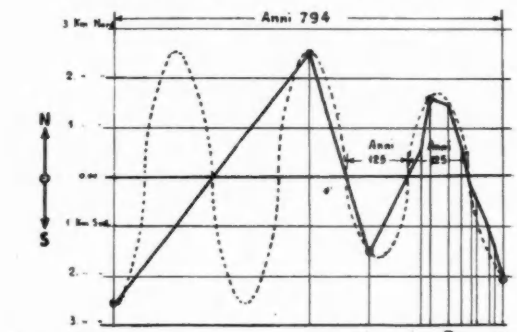


Fig. 5. Periodicity of the migrations of the mouth of the River Simeto..

this to say of the Gornalunga: "The lower channel of the Gornalunga to its confluence with the River Simeto was excavated in a direct line by the order of Pietro Galleti, Bishop of Catania (1730-1757), who, desirous of avoiding the serious inundations which occurred annually due to the obstructions of a tortuous channel, deepened and straightened it."

Thus from the data gathered together of the wanderings of this river mouth, it would appear that the excursionary inversion of the Simeto seems to gyrate about 123, 124 and 125 years periods. The graph (Fig. 5) shows this cycle of change over the last **800** years. One can note, if not relate, that the period of the cosmical cycle appears to be of **111** years, as is also the case with the periodicity of the marine life and allied phenomena of the Atlantic Ocean (Otto Petersen). On the other hand, the State Oceanographic Stations of the French Coast (Lallemand and Prevot) place the periodicity of tidal phenomena at **93** years.

(concluded at foot of next page)

Port Authorities and the Courts

Some Humorous Instances of Recent Litigation

By CAPT. H. V. HART, R.N.R. (Retd.).

Port Authorities are rather naturally situated as legitimate objects of litigation, owing to the responsibilities which accrue to their manifold activties in various directions. In spite of all (more than) "reasonable" care exercised in safeguarding their responsibilities as fully as is possible—loopholes often exist—created by human failings; nature, as represented by the weather elements, and exclusive of those within the term—Act of God; accidental occurrences; or the 1,000-1 chance, which unexpectedly, and unfortunately, comes off. In many cases, arising from any of these causes, a port authority becomes directly involved, and even sometimes to an extent as seriously to affect their financial status. In other and more numerous cases, it is concerned, merely to necessitate the attendance of certain of their Officials, to give evidence in Courts of Law, and Courts of Enquiry. This, may take the form of expert evidence as to Hydrographical and/or Tidal Data; local information as affecting navigation; or, direct evidence of fact, as an actual eyewitness of events. In fact—what has been so unkindly classified as the two kinds of witnesses! "Witnesses, and Expert Liars"!

In a large port, where many Officials are daily employed in their various duties afloat; within the area of the port, in connection with Buoyage; Surveying; Salvage, etc; and other numerous conservancy work, it frequently happens that some of the Officials become eyewitnesses to casualties, which occur within the range of their activities, and it is remarkable how quickly their presence in the locality is discovered by those involved, with the consequent result of a serving of a subpœna upon them in the event of ensuant litigation. It is almost impossible for an Official who has served the greater part of a lifetime with a Port Authority, and in constant service afloat, to have evaded visions of the law, as exemplified in the Admiralty Court; and the writer of this article far from being an exception—has figured with somewhat undue frequency in these court cases. Several of these, have not been entirely devoid of flashes of humour, to momentarily, at least, enliven their serious sides, and some of these are now recalled, in instances in which, "My Lord and Learned Council" did not disdain to permit a smile to fleetingly illuminate the austere proceedings of the Court.

It might be permitted to quote the immortal lines:—

"Even the ranks of Tuscany could scarce forbear to cheer" and substitute therefor:—"Even the ranks of heads bewigged did smile—or, thereto, near."

As having figured on many occasions, either as a Witness or as an "Expert Liar," it may be helpful to other impending, and future unfortunates, to enumerate the three Cardinal Rules of giving evidence. They are:—"Know your subject; speak the truth; don't enjoy hearing your own voice"—and to these, may also be added:—"Never! oh never, lose your temper in the box." To the ordinary "man in the street," and particularly, to the simple sailorman—the witness box proves an ordeal, and it is not unique for the latter type of witness to address Counsel, as "My Lord," in mistaken identity.

The following are selections from a number of cases, in which, a Port Authority has been either directly or remotely involved, and which necessitated the presence of their Officials in Court:—

A large vessel stranded on a sandbank in a fog, within the area of a premier port. The port's appropriate Official proceeded to her, to render salvage services, which were successful. The Port Authority ultimately became indirectly concerned with the action for salvage, brought by the assisting tugs against the vessel. The above Official was subpœned for the case, to give evidence of factual events, and to resist the claim of the tugs. In his evidence he explained how he suddenly observed the vessel in the fog—sitting high and dry on the sandbank.

During part of his cross-examination the Counsel asked him whether he went aboard and stated that he would take charge. The Witness answered in the affirmative. The Counsel inquired if that was not a very arbitary proceeding, to which the Witness replied that it was the usual proceeding under such circumstances. He was then asked if he always acted in that way. He stated that he did—always. The Counsel queried the statement "always," and asked if he meant to tell the Court that, if he saw the "Lusitania" sitting on a sandbank he would go aboard and at once take charge. On being told that he would not, the Counsel accused the Witness of contradicting himself and asked why this reply did not apply in the case of the "Lusitania." The Witness then explained that as the "Lusitania" had been sunk 15 years before, if he saw her sitting on a sandbank he would be too surprised to do anything.

Loud laughter in Court, and collapse of Counsel.

In another case, evidence was being given as to the weather prevailing at the time of occurrence of a shipping casualty, which formed the subject of this case. Evidence had been given to the effect that the prevailing gale was one of the worst ever recorded, with a wind velocity of over 90 m.p.h. The master of one of the Port Authority's tenders, who had been on the scene at the time, was then called. This man was an elderly honest, most truthful, albeit, simple soul, but afflicted, when nervous, with an appalling stammer. During his evidence, the Judge intervened with a question to him. "I suppose it *was* a terrible gale"? The witness wriggled, choked, coughed, and made several attempts to reply, and at last blurted out that it was "blowing a bit," which is the usual sailorly parlance for "blowing very hard." "My Lord" eyed him sternly, and remarked severely that evidence had been given as to its being one of the worst gales ever recorded and that the Witness had the temerity to describe it as "Blowing a bit." He then added that if he was given any more untrustworthy evidence, he would send the Witness out of the box.

Migrations of a Sicilian River's Mouth

(concluded from previous page)

The present day proposals to alleviate the drawbacks of the wandering Simeto outlet take the form of a recanalisation and straightening of the lower reaches of the river and the construction of two training moles, or breakwaters, to carry the fresh water discharge into the sea beyond the outer line of banks, as shown by the double dash lines in Fig. 1. It is also proposed to combine with these protective measures the provision of facilities to found a safe fishery harbour on the Simeto, to support the very valuable anchovy fisheries of this coast.

Bibliography.

(1) Agatino d'Arrigo. La terra che muore in Sicilia. "L'Ingegnere," April 1948. Milan—Hoepli.
Regime della Plaia di Catania. "Annali dei Lavori Publici," September, October, 1929. Rome.

(2) Olinto Marinelli. Idee Morfologiche di Carlo Gemmellaro "Rivista Geografica Italiana," Rome, April 1900.
Di alcuni scritti morfologici di Carlo Gemmellaro. "Rivista Geografica Italiana," November 1900. Rome—May, 1899.
Della Corrente Litorale del Mediterraneo con particolare riguardo alla costa orientale della Sicilia. Firenze, 1908; and "L'Universo," July 1926.

(3) F. P. Gulliver. Shoreline Topography. Proc. Am. Soc. Arts and Sciences. Vol. 34. June, 1899.

(4) "Annali Idrografici," 1936. Ministerio dei Lavori Pubblici. Pt. 11, Rome, 1939.

(5) Marco Visentini. Recherche sperimentali sulle torbide portate in sospensione dal fiume Po. "Annali dei Lavori Pubblici," 1935. Rome.

(6) Antonio de Toni. Studi geologici e morfologici sul Lido di Venezia. "Ufficio Idrografico," Venice, 1912.

(7) Eugenio Perrone. Carta Idrografica d'Italia. Ministerio di Agricoltura. Industria, e Commercio. Rome, 1891.

(8) G. Baer. Uber ein Allgemeines Gesetz in der Gestaltung des Flussbettes. Bulletin Academie, St. Petersburg, 1866.

Port Authorities and the Courts—continued

A Salvage Official of a large Port Authority was under cross-examination in the witness box, as to steps which *might* have been taken to hold up one end of a sinking vessel. The learned Counsel though doubtless fully conversant with law, possessed not even the most rudimentary knowedge of the subject of salvage, and was expatiating at length upon a theory of his own of remarkable ingenuity, though entirely lacking in both mathematical and practical sense. The method advocated by him involved the holding up of a weight of 400 tons by the cable of a small vessel, the " breaking strain " of which was 45 tons, and which incidently, would have capsized the " holding up " vessel. Counsel asked witness—" Why such a method had not been applied "? to which the witness replied—" But you couldn't do it." Counsel enquired —" Why not "? The witness slowly leant forward over the box, and a beatific smile, and sweet pitying look radiated over his face, as he very gently replied—" Because it would be so silly." Counsel then hurriedly passed on to another subject!

Another case, was that of a sunken barge in a dock, which had been raised and removed by the Port Authority, who claimed on the owners for expenses incurred in the operation, on the grounds of previous disrepair, and unseaworthiness of the barge, as having been the cause of the sinking. During the hearing, when the salvage operations involved, had been described, the defendant Counsel claimed that damage to the barge had been caused by these operations, in which, a tug had been engaged in towing on a wire attached to the sunken barge, in order to slew her partly round, and simplify " lifting " operations. He stressed the enormous power exercised by a tug of approximately 500 tons weight, and argued that *that* power (in tons) had been applied to the barge. At this point, the witness put into operation a pre-arranged signal between himself and his Counsel, to signify that he desired re-examination on that particular subject. This signal consisted of stroking his right ear! upon re-examination, his Counsel asked —" What *was* the total weight applied to the barge by the tug "? Witness replied—" The maximum pulling power of a first-class tug—i.e. 12 tons "!

Deflation of opposing Counsel!

During the same case, the Judge asked the witness, " what, in his opinion, was the cause of the sinking "? In a bright moment, the witness replied—" General debility, My Lord." This descriptive diagnosis was subsequently favourably commented upon by his Lordship, and was destined to re-appear in a later case.

To pass from Courts of Justice, to Courts of Enquiry, in which Port Authorities and their Officials are occasionally required to figure.

An interesting case, and one which involved expert evidence on the part of a Port Authority's divers, arose from the foundering, during an abnormally severe gale, of an old vessel, off the entrance to the port. This accident caused the loss of many lives, and in the ensuant Court of Enquiry, several allegations were made as to the unseaworthiness of the vessel, due to the worn state of her plating. To substantiate, or refute these allegations, arrangements were made for two most experienced salvage divers of the Port Authority, to make an examination, and report on the condition of the vessel's plating. This took place, and in due course, the report proved a most damaging one, to the cause of the vessel's owners, whose Counsel however, at once professed doubt as to the ability of a diver to determine the dimensions of plating, in the dark, and below water. In order to prove the correctness, or otherwise, of their report, both divers were blindfolded, and each was handed 12 pieces of plating of various thicknesses of about 1/16-in. dimensions, and required to state the dimensions of each piece. One diver made one error of 1/16-in. in one piece of plate, and the other diver made two errors, and thereby of course, verified their report.

One last instance, as to the assessment of value of documented evidence. In a prominent case, which eventually was taken to the highest court, the private notebook of one of the Port Authority's divers was produced in evidence. Counsel for the defendants at one time described this notebook as " a valuable document " and also, at a subsequent period, in a scathing tone, as " a miserable little book." This discrepancy in valuation was seized upon by the opposing Counsel, who holding up the offending article between finger and thumb, remarked—" . . . . . My learned friend, has, on different occasions, described this notebook, both as a " valuable document " and " a miserable little book." . . . . Now, my learned friend cannot have it both ways, and it must be either one or the other, and from the evidence heard, I leave it to . . . . . "

Memory does not register as to under which classification, this piece of evidence was ultimately recorded.

In a somwhat unusual case, in which, the witness was being cross-examined by a lecturing Counsel, he adopted the following very effective way of dealing with the latter, and succeeded in completely throwing him out of his stride. Proceedings were as follows:—the Counsel said " I suggest that . . . ." The Witness made no reply so the Counsel repeated his original suggestion and then requested that the Witness should answer his question. Thereupon the Witness said " You did not ask a question—you made a suggestion only."

It may however be generally accepted that a straightforward and obviously truthful witness obtains every consideration from both Counsel and Judge, and Dock Authority and other Officials undergoing experience in a witness box may anticipate such ordeals with comparative equanimity.

Dredger Propulsion by Diesel Engine

New Features in a Sand Suction Dredger ordered for the Bristol Channel

An informative article on the above subject appeared in a recent issue of *Lloyd's List*, and as it is likely to be of considerable interest to a number of readers of *The Dock and Harbour Authority*, we are printing it intact, with due acknowledgments.

As time goes on, the internal combustion engine is employed more and more in vessels of a type from which only a few years ago it would have been banned on grounds of high first cost or lack of reliability. According to a recent report, diesel machinery is to be fitted in a sand suction dredger ordered from a Tyne yard by Cardiff owners. The sand suction dredger is one of a class which is employed in sandy estuaries and at the mouths of rivers where there is a large tidal rise and fall. Such vessels are distinct from ordinary dredgers, in that the material sucked from the bottom of the estuary or river is not discharged overboard for reclamation purposes or dumped out at sea, but used as a marketable commodity, principally in the building trade.

The Bristol Channel area, the Dee, the Mersey, and to some extent the Solway Firth, all employ this type of tonnage, but hitherto the tendency has been to use old steamers of the coaster type adapted for the duty, rather than to build ships of an entirely new design. A coaster is, after all, eminently suitable, for it is only necessary to fit a centrifugal pump with a suction line and in the simplest cases to employ the hold of the ship to carry the sand, which can be later removed by ordinary crane and grab.

Features of New Dredger

The suction dredger now ordered, which is to be built by Clelands (Successors), Ltd., is to be 156-ft. in length between perpendiculars, 28-ft. in beam and 14-ft. in depth. The draught has not been stated, but it is essential that in ships of this kind the draught should not be excessive. The dredging apparatus is to consist of a 16-in. flexible hose line. The suction machinery will take the form of an electrically driven pump to remove the sand from the bottom of the Bristol Channel and discharge it into the hold of the ship, which, generally speaking, is to be built on the lines of a motor coaster with a poop, bridge and forecastle. It is not clear from the preliminary description whether the poop, bridge and forecastle will be separated from each other, after the manner of an ordinary coaster of, say, raised quarter-deck type, or whether (as is more likely) the poop and bridge will be combined in one. This would seem to be the more practical arrange-

Dredger Propulsion by Diesel Engine—continued

ment. The propelling machinery is to consist of a Ruston single-acting four-cycle airless-injection diesel rated for 665 b.h.p., continuously at 138 r.p.m., the latter being the speed of the shaft driven, presumably via the S.L.M. reverse-reduction gear, which is fairly standard in engines of this kind. It is not stated whether bridge control is to be fitted, though this would not be surprising in a ship like the new sand sucker, which has to be capable of fairly rapid manœuvring in the course of her duties.

As a sidelight on the use of electricity throughout in small specialised ships, it may be noted that a separate diesel-generator to supply the current to the electric suction pump is to be fitted in a pump-room forward. This has the advantage that the machinery for the pump is self-contained, just as a similar arrangement for the trawl winch in a trawler might be, but it does mean that, with such a lay-out, personnel will be required in two parts of the ship at once. One would have thought that, as the pump is driven electrically, a diesel generator situated in the main engine-room could have supplied current to the motor driving the pump, with remote control of the motor from the navigating bridge, but perhaps space considerations did not permit. Apart from the generator for the sand pump, there are two other diesel-generators fitted in the engine-room, one of which drives a pump-compressor set and the other a generator. It would appear that electricity will be used throughout for auxiliary purposes. In fact, a very high specification has been aimed at in this little ship which certainly cannot be cheap to build. What is important is that a further application of oil-engine drive to another member of the dredger family is being witnessed, and one of special interest in view of the historical survey of the dredger given in a recent book by Dr. J. van Veen entitled "Dredge, Drain, Reclaim; The Art of a Nation."

Dutch and British Practice Compared

Dr. van Veen traces the employment of dredgers in all their applications. It may be a far cry from the ship described above to the old Krabbelaars of the XIIIth century, in which iron harrows underneath the ship scratched the bottom of a channel during ebb tide while side wings and sails helped to move them, but we can, nevertheless, show a distinct relationship, even though in the Amsterdam mud mills of 1650, horses provided the driving power, and a windlass served to lower the ladder by which the mud was removed.

As an excuse for the slowness with which diesel engines have been adopted in dredging craft, it may be recalled that the mud mill was in use from before 1600 until as recently as 1860. The transport of sand and mud by water, Dr. van Veen points out, is still one of the most economical methods, and he mentions that in the total Dutch dredging fleet there are no fewer than 53 sand pump dredgers with discharge pipes, as well as 34 pumping plants. Up to the present Holland has perhaps been less forward than other nations in the employment of the diesel engine for the powering of such ships and craft, though she has in fact constructed some noteworthy ships of this kind with diesel-electric drive for export to Argentina. In past years the Dutch have taught this country much about dredging and reclamation, but in the last few years British owners have perhaps taken a leaf out of the Dutch book in the ordering of new craft fitted with diesel and diesel-electric propulsion. Of this the craft now ordered for the Bristol Channel is an example, and she should go a long way towards giving confidence to harbour authorities to order similar ships.

The new ship will employ straight diesel drive for propulsion and diesel-electric for auxiliary duties, including the most important one, the sand pump itself. Many operators (the Mersey Docks and Harbour Board, for instance) would argue that the logical plan for such craft is full diesel-electric machinery. In the meantime, straight diesel for driving the screw and a diesel-electric installation for auxiliary purposes should give reliable and economical results.

Development Plan for the Port of Helsingborg.

Extensions to harbour facilities at the Port of Helsingborg, drawn up by the harbour board have been approved by the town council. The scheme provides for new docks and industrial sites, etc., and the total cost will amount to 31 million kronor.

Fire Protection at Port of San Francisco

By H. D. ROTHROCK.

Following Admiral Higbee's article on "Security of Port Installations and Ships in Harbours" which appeared in our last month's issue, below is a contribution to the subject, which we think will prove interesting, from a writer connected with the Port of San Francisco, California.

If you owned a home worth $10,000, and in the past five years had a total fire loss of $3.60 you would be thankful that the $3.60 loss wasn't a lot more and you would try not to have a loss even that size in the next five-year period, but you wouldn't be particularly concerned over the loss of the 36-thousandths of 1 per cent. nor would you be criticised for taking inadequate precautionary measures.

The 36-thousandths of 1 per cent. used in this example is not a figure picked at random but represents the actual fire loss suffered by the Board of State Harbour Commissioners on its extensive Port of San Francisco property in the past five years. We wish the percentage were zero and we're not particularly proud of it, but we do think it points up a reasonably effective system of fire prevention, an excellent system of fire fighting, and fine co-operation by the San Francisco Fire Department.

Before describing some of the reasons for this low loss figure let me emphasise that the danger of fires on waterfront property has always been a more serious problem than elsewhere because of a number of factors including the character of pier construction, the nature of waterfront operations and the difficulty of fighting waterfront fires. Although all the modern piers that we are building have concrete piling and concrete decking, some of the older ones are made of combustable materials with inadequate fire breaks or draught stops to prevent the rapid spread of fires.

Piers are endangered by fires on vessels and floating materials, and certain practices with respect to cargo handling are not always strictly in accord with best fire prevention practices. When you realise that access to piers by land fire fighting forces is confined to the narrow end opening and that access to the substructure is confined to small openings in the pier deck or between the supporting pilings at the water level, the problems involved are obvious and the 36-thousandths of 1 per cent. loss in the past five years is somewhat remarkable—remarkable, but not all luck.

"No Smoking" rules, and rules governing other fire hazards, excluding the use of welding machines, compressors, loading of hazardous cargo and others are enforced by fire marshals, state wharfingers, state police and steamship company watchmen. Fire marshals maintain a round-the-clock patrol in radio-equipped cars and on foot. Of great importance in their work in a daily inventory of fire hazards prepared by each wharfinger and consolidated by the Chief Wharfinger. Equipped with this list the fire marshals can keep particularly close watch on the items constituting extra danger. The Chief Wharfinger's office is equipped with a fire alarm system connected with that of the City Fire Department. Many waterfront employees are trained by the fire marshals in the use of extinguishers and pumping units, provided by the port.

The low fire loss in the past five years results only partly from the precautions taken. Fires still start, but most are extinguished in their very early stages because of the extremely prompt response of the city land-borne fire fighting companies, many of which are located near enough or actually on harbour property, to reach most fires in the important first few minutes—if the alarm is turned in promptly before any local efforts are made to fight the fires.

Indicative of the effciency of the land-borne equipment is the fact that although two fireboats capable of pumping 10,000 gallons per minute, protect the harbour from the water side, they have been required to pump on fires damaging harbour property only four times in the past five years.

In spite of the relatively good record of the past five years, the potential danger of waterfront fires remains great and requires constant watch-dog thinking and acting in terms of "fire protection" on the part of everyone using the port and its facilities.

Deep Sea Towage

Nylon Hawsers Used with Success

The satisfactory use of large nylon hawsers for heavy deep-sea towage was recently demonstrated in a series of interesting tests undertaken by the Overseas Towage & Salvage Co., Ltd., of London, when the company's tugs "Dexterous" and "Marinia" successfully completed the delivery of six steam ferries from Holland to Istanbul, a distance of nearly 3,000 miles. This is the first time nylon hawsers have been used for a voyage of this duration.

The idea of using nylon for ocean towage occurred to Mr. F. J. Andrews, Managing Director of the company, soon after D-Day in Normandy when he watched bombers picking up gliders from the ground with a slender cord which from the dimensional point of view seemed inadequate for the tremendous strength required.

The large and powerful tugs under the company's control require manilla hawsers of 18-in. to 20-in. circ. and weighing several tons. After an ocean tow, these hawsers were often too stiff, from long immersion, to bend round even the outsize capstans of the tugs. Further, by reason of their weight these manilla ropes were frequently damaged by dragging over rocks, and sometimes wreckage, on the sea bed, when shortening in on the completion of a tow.

Soon after the war, British Ropes, Ltd., at their Synthetic Cordage factory at Leith carried out experiments with nylon rope up to 6-in. circumference, and at the request of the Towage Company extended their experiments to large dimension nylon hawsers for ocean towage work. It was found that a 9-in. hawser had an elasticity up to 40%, as against 16% of manilla, and that when the tension was released, the hawser retracted to within a small percentage of its original length. The weight was only one-quarter that of manilla and so risk of underwater damage was considerably reduced.

The Towage Company revealed that the first full scale test was made when towing half of a tanker from Brest to Kiel. Off the Dover coast, a sudden gale of great severity sprang up and the tug's captain was anxious about the strain which he asserted would have parted any other rope, but the 9-in. nylon hawser, because of its high degree of resistance to shock loading, took the strain. The tow was held and safely delivered.

This 9-in. circumference rope has now completed the towing distance of over 15,000 miles with vessels ranging up to more than 11,000 tons. In view of this success, a 10-in. hawser, the largest ever made, was then constructed. This rope, which has now completed 12,000 miles on board the company's tug "Dexterous," is 540-ft. long, and was built up of 6¼ million filaments and has a breaking load of 90 tons. On this basis it compares favourably with the highest grade manilla rope of 20-in. circumference.

On the weight basis, as already remarked, the saving in handling effort is considerable. Large sizes of manilla hawsers take the combined strength of all members of a tug's crew to handle, and by comparison, nylon rope is a lightweight and handles easily, wet or dry.

FOR SALE.

"GILL 30" AXIAL FLOW PUMP UNIT FOR SALE. Virtually unused. Capacity 3,600 cu. ft. of water per minute; with or without Paxman type 4RW diesel engine. Suitable for land drainage, sewage pumping, etc. Apply: Box No. 106. "The Dock & Harbour Authority," 19, Harcourt Street, London, W.1.

FOR SALE.—Handy Steel Launch, cabin forward, cockpit aft, for transport of personnel or towing. Diesel powered. Spares included. Price £1,500, or near offer. Reply: Box No. 109, "The Dock and Harbour Authority," 19, Harcourt Street, London, W.1.

WANTED.

URGENTLY WANTED.—Back numbers of the "Dock and Harbour Authority" for the years 1940-46. Write Box No. 101, "Dock and Harbour Authority," 19, Harcourt Street, London, W.1.

OFFICIAL APPOINTMENTS.

THE PORT OF LONDON AUTHORITY invite applications from British subjects for appointment as Assistant Engineers in the Docks and Marine Engineering Divisions of the Engineering Department—scale of pay £750 by annual increments of £50 to £900 per annum. Preference will be given to candidates not over 40 years of age.

Candidates for appointment to a Docks Division must be Corporate Members of either the Institution of Civil Engineers or the Institution of Mechanical Engineers, with experience in maritime civil engineering construction and maintenance or in the erection and maintenance of machinery and plant used in Dock and Railway Undertakings.

Candidates for appointment to the Marine Engineering Division must be Corporate Members of either the Institution of Mechanical Engineers or the Institution of Naval Architects, with experience in the design, construction, and maintenance of the hull and machinery of steam or diesel harbour craft.

Successful applicants will be required to become members of the Port of London Authority's contributory superannuation scheme.

Application must be made on a form to be obtained from the Establishment Officer, Port of London Authority, Trinity Square, E.C.3.

F. W. NUNNELEY,
Secretary.

ENGINEERS FOR HYDRO-ELECTRIC DESIGN—NEW ZEALAND.

Civil Engineers are required for design in Wellington on the new programme of Hydro-electric projects. Works scheduled in the next few years aggregate well over one million horsepower and include schemes which are very large by world standards, such as the Roxburgh and Benmore projects, both of 300,000 k.w. and the Waikato Development totalling 1 million H.P.

Opportunities for experience and responsibility are very great and include work on design, specification, preparation of contracts, and contact with work in the field, on structures of concrete, earthwork and steel.

Applicants should hold a recognised university degree in civil engineering and, for the more senior positions, should preferably have experience in the design of civil engineering structures with a background of construction experience.

Initial appointment between £447 and £847 with opportunity to rise to highest positions in the service. Maximum salary for executive engineers at present is of the order of £1,150.

For further particulars, apply High Commissioner for New Zealand, 415 Strand, London, W.C.2, by whom applications, in duplicate, must be received by 30th November, 1949.